Riverbend Water Resources District
Phase 3 Report on Water Treatment Plant and Raw Water Intake Site Selection

Submitted To Riverbend Water Resources District

By

CH2M HILL
and
MTG Engineers and Surveyors

August 29, 2012

STATE OF TEXAS
EDWARD M. MOTLEY
48243
REGISTERED
PROFESSIONAL ENGINEER

8-29-12

This report was prepared under the supervision of
Edward M. Motley, P.E.
On August 29, 2012
Texas Registered Professional Engineer No. 48243
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Executive Summary

ES 1 Introduction

This study was commissioned by the Riverbend Water Resources District (RWRD) to identify a potential new water treatment plant site and a raw water intake site on Lake Wright Patman. The study also presents the costs of developing a new 20 mgd water treatment plant and raw water intake system to replace the system that has become known as the Member City System. The study was funded in part by a grant from the Texas Water Development Board and in part by the RWRD.

The water supply system that has become known as the Member City System was constructed in the 1960s. This Member City System includes a raw water intake and pump station on Lake Wright Patman, the New Boston Road Water Treatment Plant, a raw water pipeline that conveys water from the lake to the water treatment plant, and a Member City Pipeline that delivers treated water to the various member cities. The system is operated by Texarkana Water Utilities for the benefit of the member cities that include Texarkana, Texas, Avery, Annona, Dekalb, Hooks, Maud, Nash, New Boston, Red River Redevelopment Authority (TexAmericas Center), Red Water and Wake Village. This system has served the community well for the past 50 years, but many components are in need of replacement. The RWRD Member City System should be improved to provide a long term solution to the North East Texas area's water supply needs, providing high quality water that meets current rules and guidelines while allowing for expansion to meet future growth and the flexibility to meet future water quality rules.

The RWRD was created by the Texas Legislature in 2009 to provide more governance for the group that had become known as the "Member Cities". RWRD is authorized to provide water supply and potentially other services to its member cities and possibly other entities in Bowie County, Texas and surrounding counties.

This Phase 3 Study is the third phase of studies commissioned by the RWRD relating to its future water supply. CH2MHILL and MTG Engineers and Surveyors (MTG) completed two previous studies for the RWRD. The scope of work for the first study was to become familiar with the newly formed district and the water supply issues facing it. There was no deliverable associated with the Phase 1 Study. The Phase 2 Study recommended that RWRD construct a new 20 mgd (expandable to 60 mgd) water treatment plant.[1] The recommended plant is to use a treatment process consisting of coagulation, clarification, ozonation, and biological filtration. The Phase 2 Study also recommended that the Riverbend Water Resources District construct a new raw water intake in a deeper area of Lake Wright Patman.

Previous Studies by HDR Engineering, completed for Texarkana Water Utilities, recommended that the New Boston Road WTP be renovated new membrane filters constructed to replace the existing multimedia gravity filters. The HDR Study also recommended minor "short term" improvements at the Lake Wright Patman Raw Water Pump Station. The HDR Study did not address current or future

[1] CH2MHILL and MTG Engineers and Surveyors, Riverbend Water Resources District Water Supply System Phase 2 Study, XXX

expansion of the New Boston Road WTP or replacement of the raw water intake and pump station as these improvements were not within the scope of the HDR Study[2].

The scope of this study is limited to the RWRD Member City System, and it identifies improvements to the system that will assure a long term high quality water supply to the members of the Riverbend Water Resources District.

ES 2 Existing RWRD Member City System

Previous studies completed by CH2M HILL and MTG Engineers and Surveyors for the RWRD and by HDR Engineers commissioned by Texarkana Water Utilities have identified concerns and needed improvements to the existing RWRD Member City System. These concerns were primarily related to the age and long term reliability of the system and included:

- The raw water intake in Lake Wright Patman is in shallow water (approximately five feet of water above the top of the intake at the lowest conservation pool level) thus preventing the Member Cities from accessing their full water rights from Lake Wright Patman
- The raw water pump station is over 60 years old and in need of renovation or replacement. Replacement is more desirable to provide a deeper structure that can access the Member Cities' full water rights from Lake Wright Patman.
- The raw water pipeline from the raw water pump station to the New Boston Road WTP has diminished capacity due to increased friction. HDR Engineers recommended restoring that capacity by cleaning the pipe and replacing the raw water pumps, but the structural integrity of the pipe will have to be tested and validated to confirm that the pipe will withstand the higher operating pressures long term.
- The New Boston Road WTP is also over 60 years old and in need of renovation or replacement. The existing process does not adequately address frequent taste and odor issues originating from algae blooms in Lake Wright Patman. The existing plant also produces water that does not reliably meet the disinfection by-product rule. Maintenance of disinfection residuals are also a concern in the remote areas of the distribution system. The plant is configured in such a way that makes renovation of the filters and pump stations very difficult without long term shut downs and does not lend it to being expanded.
- The RWRD Member City Water Transmission system is reported to be in good condition and has the capacity to meet the Member Cities' immediate needs. Some sections may need additional capacity if additional members or customers are added to the system.

ES 3 Project Requirements

The proposed system should be planned to provide a cost effective and reliable water supply for all of the Member Cities. The system should be expandable so that it can supply the projected growth for the Member Cities and that of any new members or customers that join the system. To this end, the baseline initial capacity of the system will be planned for 20 mgd, but alternatives, with costs, will be presented for 25 mgd and 35 mgd. The system will be planned for an ultimate capacity of 60 mgd which will meet the

[2] HDR Engineering, Inc.; Evaluation of Lake Wright Patman Regional Water Facilities; June, 2010

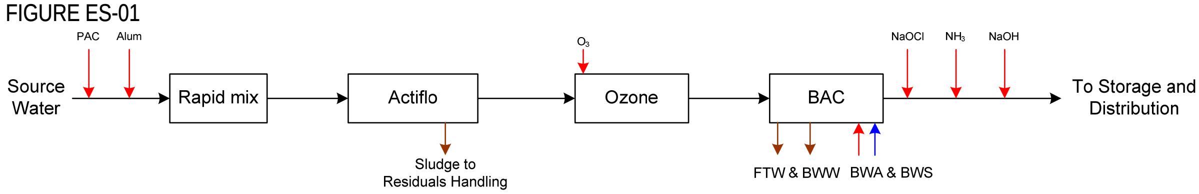
needs of an equivalent population of 200,000, assuming a per capita consumption of 150 gallons per capita per day and a 2 to 1 peaking factor.

ES 4 Water Quality Goals and Process Recommendations

The proposed system should be planned to meet the current and reasonably anticipated Federal and State Drinking Water rules. The existing New Boston Road Water Treatment Plant has experienced issues with disinfection by-products and high filter turbidities in the past. This plant was designed to meet different treatment requirements than those now required by the regulatory agencies. In addition, the water treatment process should be designed to address the taste and odor issues that have historically plagued the existing New Boston Road Water Treatment Plant. These issues should be specifically addressed in the water treatment process planning.

The treatment process selected in the Phase 2 study is shown in Figure ES-01. The process was selected based on a cost-benefit analysis using Decision Science techniques. .

FIGURE ES-01



These unit processes include ozonation and biologically active carbon (BAC) filters. Both of these processes have been successfully applied in waters with characteristics similar to that found in Lake Wright Patman to address taste & odor concerns, high disinfection by-product concentrations and concerns with maintaining disinfection residuals. Enhanced coagulation coupled with ozonation and BAC filters is a proven multi-barrier process to remove total organic carbon (TOC), a precursor to disinfection by-products. Ozonation coupled with BAC filters is also a proven process to remove taste & odor compounds to levels below human perception thresholds and to produce water with a stable disinfection residual. The recommended process was tested by CH2M HILL using Lake Wright Patman water and found capable of producing a water quality that meets the objectives of the Riverbend Water Resources District.

ES 5 Raw Water Pump Station and Intake Site

Studies by Freese and Nichols indicate that Lake Wright Patman needs to operate down to its silt pool elevation (215.25 feet NAVD) for the Member Cities to have access to their full water rights in the lake.[3] The location of the existing raw water intake does not allow for reliable operations down to this level, despite previous and currently planned dredging at this location. A new location, shown on Figure ES-02 provides water as deep as 204 feet mean sea level (msl) thus providing the Member Cities access to their full water rights.

[3] Freese & Nichols; System Operation Assessment of Lake Wright Patman and Jim Chapman; January 2003

The design concept recommended for the new raw water intake and pump station is similar to the existing system, a raw water conduit extending out into the lake to a point where the desired intake elevation is above the lake bottom elevation and a raw water pump station located on the shoreline using multiple vertical pumps in a wet well configuration. The raw water conduit will require excavation of the lake bottom so that the conduit can be installed at a maximum elevation of 204 feet msl.

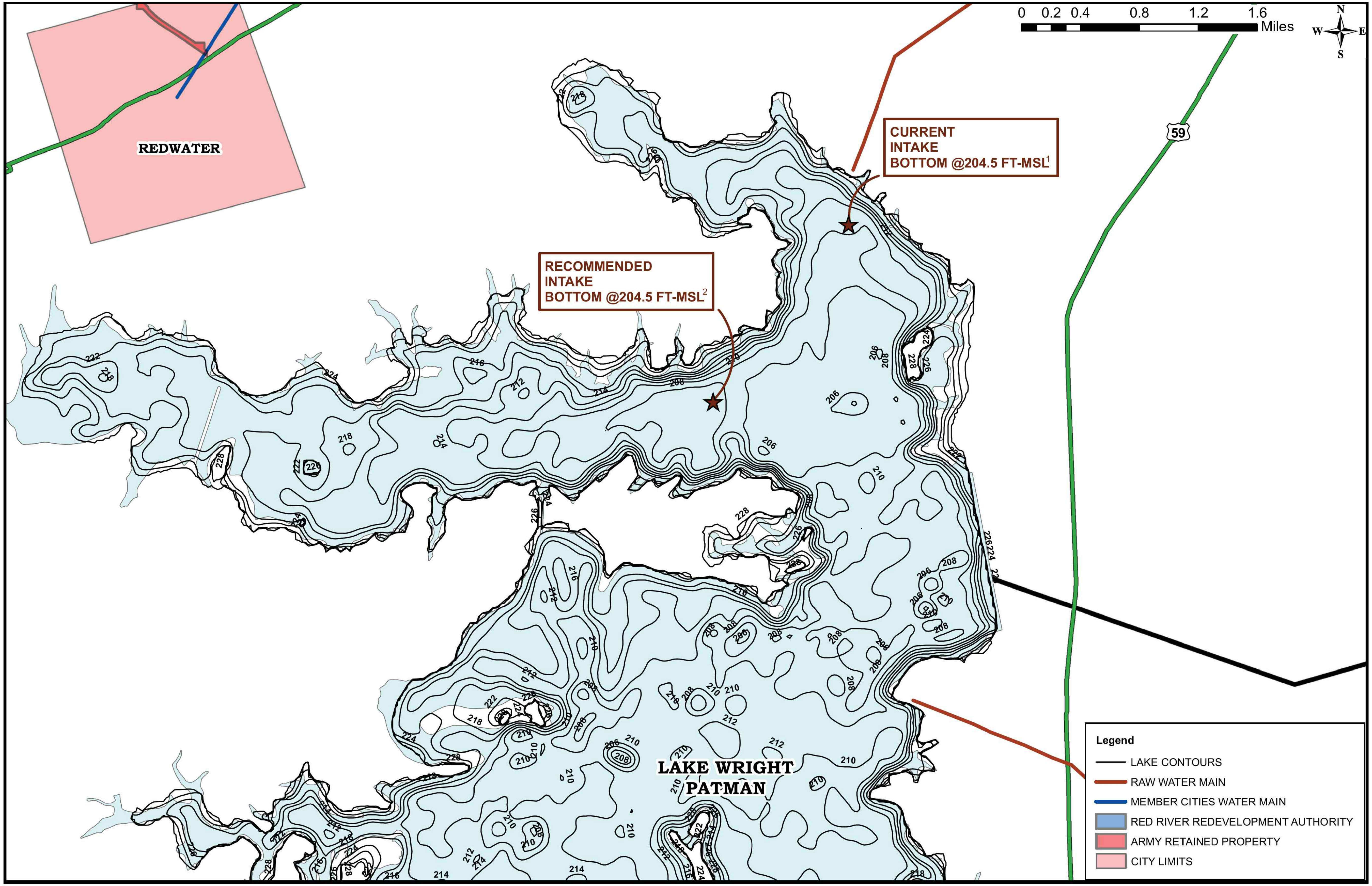


FIGURE ES-02
LAKE WRIGHT PATMAN
RECOMMENDED INTAKE LOCATION

CH2MHILL

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ES 6 Water Treatment Plant Site

The water treatment plant site, be it the existing site on New Boston Road or a new site, should have certain characteristics that allow for the efficient development and operation of a water supply system for the Member Cities of the Riverbend Water Resources District. The following summarizes those criteria:

- Site Suitability – The site should have usable sufficient area to efficiently develop a 60 mgd water treatment plant; therefore, the site should have approximately 50 usable acres (30 acres if off-site disposal of sludge through the sanitary sewer system is an option). The site should be rectangular with a length to width ratio of no more than 3 to 1. The site should be gently sloping with grades of one to five percent. The site should not be encumbered by floodplains, drainage ways that convey off site water, or any other constraints to efficiently developing the site as a water treatment plant.

- Accessibility – the site should be accessible to the raw water supply source, Lake Wright Patman. Accessibility to raw water supply does not imply that the site should be adjacent to the lake, but it should be in the proximity to a direct line between the raw water source and the existing RWRD Member City Treated Water Transmission Pipeline so that development of the water supply will not require unnecessary lengths of pipeline, either raw water or treated water. The site should also be accessible to major roadways to facilitate delivery of construction materials and water treatment supplies, and to reliable electrical power for energy for the water treatment plant.

- Environmental – The site should not include any environmentally sensitive areas such as critical habitat for threatened or endangered species, wetlands or culturally significant sites.

- Community Concerns – The site should be consistent with existing and planned land uses (noise, lighting and chemical storage), zoning, and should not create a traffic nuisance from construction and/or operations traffic.

The size of the site was based on the land area required to accommodate the projected maximum future capacity of the plant (60 mgd) with the processes anticipated to treat Lake Wright Patman water. Using the design criteria required by the Texas Commission on Environmental Quality (TCEQ) for water treatment plant design, the estimated minimum area required for the treatment facilities is 50 acres. Depending upon the topography of the land, existing easements or floodplains, and the configuration of the facilities, a larger area may be required. A larger site would provide additional area for a buffer zone between the plant and adjacent neighborhoods as well as improve on-site aesthetics and provide room for future treatment processes should future regulations or source water quality changes require additional treatment.

Based on the above criteria, and anticipated land availability a total of six sites were selected for evaluation. These were:

- Site 1A – The New Boston Road WTP (may require expansion of the site to allow plant expansion)
- Site 1B – Along the Jarvis Parkway corridor near its intersection with the existing member cities raw water main
- Site 2A – Property owned by the City of Wake Village on FM 2148

- Site 2B – Along the FM 2148 corridor and slightly north and west of Site 2A as an alternative in the event that the Wake Village property is unavailable or improperly configured.
- Site 3 – Property owned by the TexAmericas Center in the former Lone Star Army Ammunition Plant (formerly Red River Redevelopment Authority) along Bowie County Parkway (former Central Avenue)
- Site 4 – Property owned by the TexAmericas Center in the southwest corner of the former Lone Star Army Ammunition Plant and contiguous to the Red River Army Depot.

The location of these sites is shown in Figure ES-03.

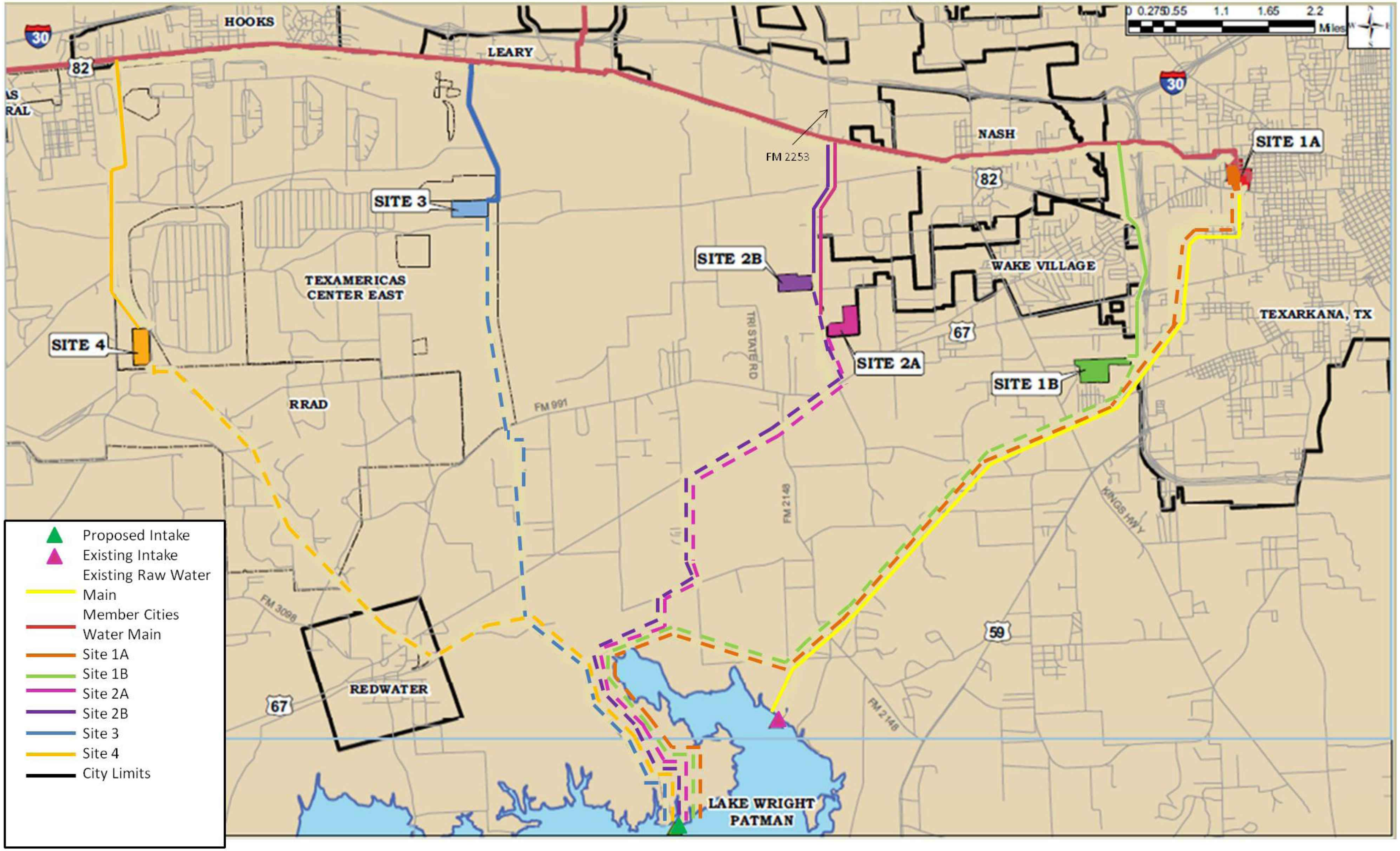
The candidate sites were objectively evaluated against the established site criteria to identify the most desirable site. Site number 3 scored the best of the six sites and is recommended. Site selection was heavily impacted by construction and operation costs associated with raw and finished water pipeline lengths as well as neighborhood considerations associated with site location and the need for mitigation of wetlands or floodplain.

The existing New Boston Road Plant site was found to have a number of constraints that made it less desirable than the recommended site. Much of the existing plant site lies in the floodplain and some portions in the floodway. A map of the New Boston Road Plant site with the floodplain limits overlaid is shown in Figure ES-04. Mitigation of these constraints resulted in the need to acquire a number of residential lots to construct the new water treatment units. The cost and social impacts of such a configuration made the further development of the New Boston Road plant site not feasible.

ES 7 Connection to RWRD Member City Water Transmission System

The Riverbend Water Supply System should be planned to provide a safe and reliable water supply to each of the District's members and their customers at an affordable cost. The critical parameters that must be met include system pressure throughout the system and water quality at each delivery point. Meeting these parameters at an affordable cost requires that the system be planned so that it can operate efficiently through the reasonably anticipated operating scenarios.

The existing water transmission system operates at the Texarkana Water Utilities (TWU) retail system pressure gradient which is more than adequate to deliver water to Annona, the most remote RWRD Member City. The TWU is a jointly operated water department of the Cities of Texarkana, Texas and Texarkana, Arkansas. The system could be more efficiently operated if the bulk of the system (west of FM 2253) were disconnected from the TWU system and allowed to operate at a minimum pressure of 25 pounds per square inch (psi) or the pressure required to service each delivery point, whichever is less. This is the most efficient location to separate the TWU system from the RWRD Member City System and a location that minimizes impacts to the two systems and gains the maximum benefits. This location does leave some overlap between the two systems in that water delivered to Nash and Wake Village will still be conveyed through a part of the TWU system. This approach is possible because the RWRD Member City System is not a primary fire protection system. The fire protection outside of the TWU system is provided by the member cities own water distribution systems. The benefit of this new configuration is the members will only have to pay for the energy to deliver the water at the specific pressures required to meet system requirements. Under this configuration, the TWU system will still operate at its current system pressure. The full implementation of this approach is subject to further analysis and assessment during the design development phase.



SITE PLAN
1"=100'

FIGURE ES-03
SYSTEM CONFIGURATION
ALTERNATIVES

CH2MHILL

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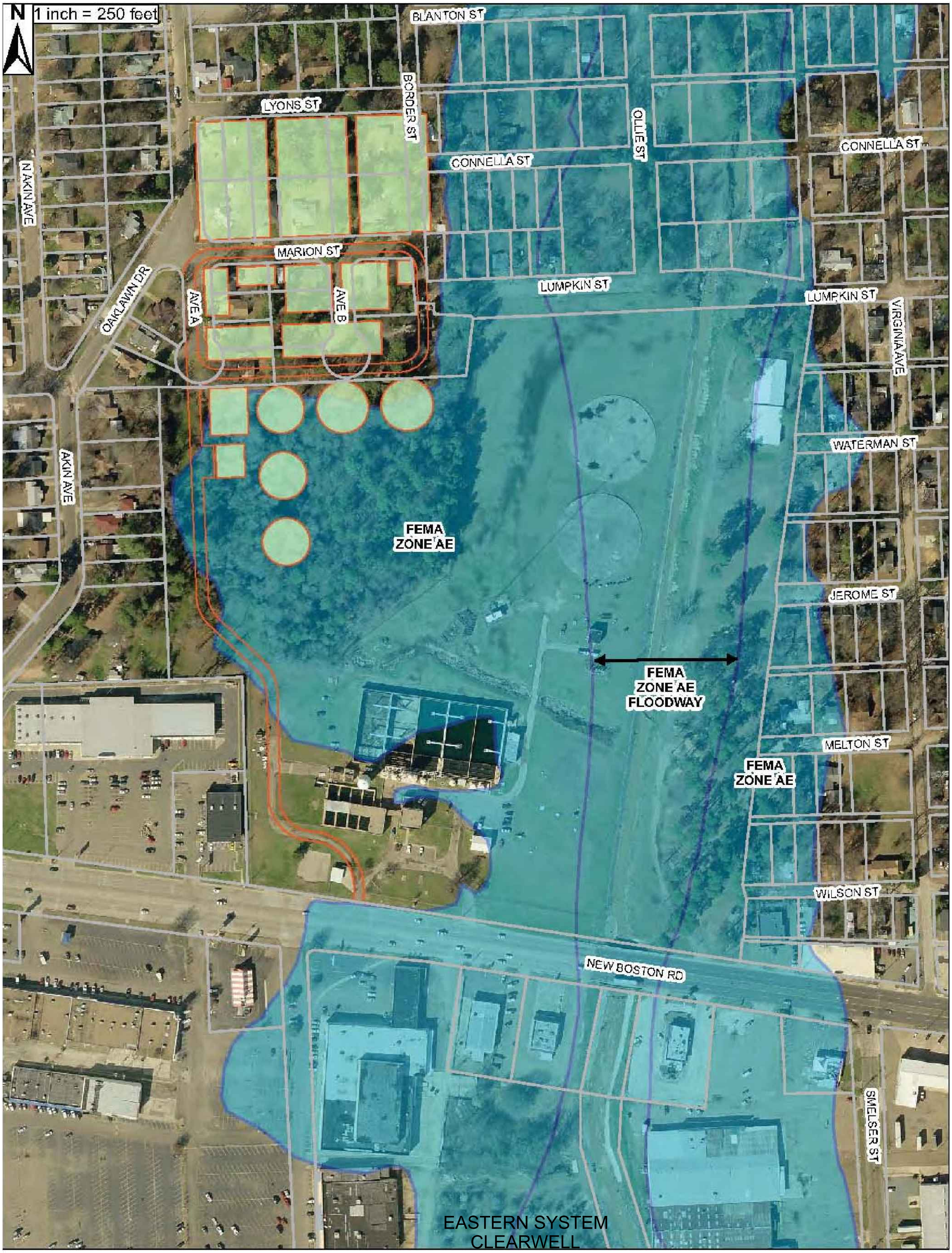

FIGURE ES-04
FLOODPLAIN LIMITS
NEW BOSTON ROAD WTP

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CH2MHILL

Figure ES-05 is a schematic of the recommended connection to the RWRD Member City Water Transmission System. This configuration isolates the TWU system from the system that delivers water to all members west of FM 2253. Nash and Wake Village will continue to be served from the TWU system. Water flow through their meters will need to be subtracted from the TWU delivery meter reading to determine the quantity of water delivered to TWU. By isolating the TWU system, the pressure in the remainder of the RWRD Member City System can be reduced to a level that meets the specific requirements to deliver water to each member and maintain a minimum system pressure of 25 psi. This configuration also isolates every RWRD Member City, including TWU, from the RWRD Member City System thus protecting the water quality in the system; however, the system has the flexibility, through valve-controlled interconnections, to operate at the higher pressure should the need arise.

ES 8 Implementation

Permits & ROW - Development of the new water supply system for the RWRD will require some permits to be secured. The City of Texarkana holds water rights permit number CA 4836 which grants the City 45,000 acre-feet per year from Lake Wright Patman for municipal use and another 135,000 acre-feet per year for industrial uses. The quantity of raw water for municipal uses is more than enough to support a 60 mgd water treatment plant assuming a 2 to 1 peaking factor; therefore, the quantity of water available is sufficient for the District's needs in the foreseeable future. If the raw water intake location is changed, a minor permit amendment will be required to designate the new intake point. Such an amendment is typically an administrative procedure.

Construction of the raw water intake will require a Section 404 permit from the US Army Corps of Engineers (USACE), but the scope of the project will most likely fall under a Regional General Permit. Additionally, Lake Wright Patman is owned and operated by the USACE and the raw water pump station will potentially be located on USACE property. The Operations Division of the USACE will require review and approval for any construction in the lake and will require an agreement to construct facilities on USACE property.

The recommended water treatment plant site is located within the Tex Americas Center. The adjacent land uses and zoning are both industrial/commercial. The proposed water treatment plant is consistent with the adjacent land use and zoning so no zoning changes will be required. The land for the water treatment plant will have to be acquired from the Tex Americas Center.

Much of the recommended raw water and treated water pipeline routes are along existing public right-of-way, but there are short segments where right-of-way will need to be purchased.

Both the water treatment plant and the raw water pump station will require significant amounts of reliable electrical power. To assure reliability, both facilities should have either redundant power feeds at or a robust single power feed with local back-up power generation on site.

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Contact publicinfo@twdb.state.tx.us to request this page

Schedule - The development of the new water supply for the RWRD is anticipated to take approximately 39 months as outlined below:

- Preliminary Design,– 6 months
- Final design – 6 months
- Right-of-way acquisition, and permit approvals – 12 Months (concurrent with preliminary & final design)
- Construction – 24 months
- Start-up and commissioning – 3 months

Cost Projections - Major costs for this project consist of land/right of way acquisition, intake facilities, raw water transmission lines, water treatment facilities, finished water transmission lines, and professional services including engineering, land acquisition assistance, surveying, geotechnical, and ecological evaluations. A brief summary of expected costs in each of these areas is described below.

Land Acquisition/Right of Way – Land costs will vary based on the site selected as described in the Section 6 – Water Treatment Plant Site. Typical, land costs for the Texarkana area are $10,000 per acre. Except for Site 1, the land costs for each of the prospective WTP sites are anticipated to be at or below the average cost. Due to the high number of residences requiring purchasing for Site 1, land costs are anticipated to be significantly more than the average cost. The anticipated average cost for a 50-acre plant site will be $500,000.

Pipeline right-of-way costs can also vary considerably from near zero for existing right-of-ways to $60,000 per 1000 linear feet for right-of-ways through developed areas. Using a typical mixture of existing, rural, and developed areas where the pipelines will be installed indicates that right-of-way costs on this project will average about $15,000 per 1000 linear feet of pipe. Total cost for right-of-way acquisition will vary based on the expected length of the required pipeline which is dependent on the intake and WTP sites selected.

Construction Costs Basis – Construction costs were developed using CH2M HILL's construction cost database and CH2M HILL's proprietary CH2M HILL Parametric Cost Estimating System (CPES). The purpose of CPES is to generate quick, relatively accurate, and detailed cost estimates at the conceptual stage of a project, before little or any design work has taken place. The system contains many "mini-models" or cost estimates of facilities that are based on real projects. These mini-models have relationships (or algorithms) built into them that allow the system to adjust their costs based on project-specific information supplied by the user. This system takes actual cost data from the construction of water treatment facilities across the country and develops standard layouts and associated costs for each of the unit processes under consideration. This tool is useful in developing conceptual layouts and budget level costs and for comparing various treatment alternatives. In Phase 2 of this project, CPES was used to evaluate the anticipated costs of treatment alternatives and was used to help select the process with the lowest cost-benefit ratio. Contingencies are included in the construction costs.

Intake Facilities – The costs for the intake facilities include the construction costs for the raw water intake and the raw water pump station. The intake pipeline and the raw water pump station structure will be designed and constructed to accommodate the ultimate capacity of the system (60 mgd) plus an additional

5 mgd for industrial customers, but the equipment installed in the pump station will only be designed to match the water treatment plant capacity. Plus the 5 mgd for industrial customers

Raw Water Transmission Lines – The costs for the raw water pipeline include construction costs for a raw water pipeline. The costs assume the initial capacity of the pipeline will be one-half the ultimate water treatment plant capacity (30 mgd) plus 5 mgd for future industrial customers. A second parallel pipeline will have to be constructed when the Water Treatment plant is expanded beyond 30 mgd. The costs also assume that Water Treatment Plant Site 3 is the selected plant site

Water Treatment Facilities - The costs for the water treatment plant include the costs for the unit processes discussed in Section 4 of this report including sludge lagoons. Costs for plant capacities of 20 mgd, 25 mgd and 35 mgd are presented for information purposes. A plant capacity of 20 mgd will be required to replace the capacity of the existing New Boston Road WTP.

Finished Water Transmission Lines – The costs for the finished water pipelines include the costs of the pipeline that connects the water treatment plant to the RWRD Member City System. The pipeline construction costs are based on a capacity that is 1.25 times the water treatment plant capacity to allow for some diurnal peaking.

Professional Services – Professional services include engineering and other professional services to complete planning, permitting, and design of the new water supply facilities.

Summary of Anticipated Costs – A summary of estimated costs for each factor is shown below in Table ES-01. These should be considered budget level costs with a level of accuracy of +/- 20%. Costs are assuming that the highest ranking site in the site selection process (Site 3) is used.

Table ES-01 Projected Costs of Water Supply System

	20 mgd	**25 mgd**	**35 mgd**
Land Acquisition/ROW	$500,000	$500,000	$500,000
Intake Facilities	$13,800,000	$14,000,000	$14,500,000
Raw Water Pipelines	$20,710,000	$20,710,000	$20,710,000
Treatment Plant	$52,350,000	$57,900,000	$69,560,000
Treated Water Pipelines	$6,400,000	$6,400,000	$6,400,000
Professional Services	$9,280,000	$9,890,000	$11,080,000
Total	**$103,040,000**	**$109,400,000**	**$122,750,000**

Treatment plant costs could be reduced by deferring the construction of the ozone facilities until a later date. It is anticipated that this deferral would reduce the initial capital cost by about $12M. This deferral would have a significant impact on finished water quality, however. Taste and odor removal would go from excellent to poor, TOC removal would go from excellent to moderate, and pathogen removal would go from good to moderate. Current water quality regulations will still be met but there will be less ability to meet potential future regulations without the ozone.

The projected costs are significantly higher than HDR Engineering's projected cost to replace the filter units at the New Boston Road WTP because the two projections are for projects that are not equal in scope or value to the Member Cities. The Scope of the HDR project is to install new membrane filters at the New Boston Road WTP to replace the existing granular media filters, repair the existing flocculation sedimentation basins, and add powdered activated carbon facilities at the raw water pump station. The limitations of the HDR Engineering scope are due to the limited focus of the HDR Engineering study as directed by Texarkana Water Utilities. These improvements address only the most urgent needs for the water supply system. The following table (Table ES-02) compares the scope and benefits of the two projects:

Table ES -02 Comparison of Scope and Benefit of Water Supply System Improvements

Scope Item	HDR Project	CH2M HILL Project	Benefit
Replace raw water Intake & pump station	Not Addressed	New raw water intake and pump station in deeper water	Allows for Member Cities to access full water rights in Lake Right Patman. Replaces 50 year old pump station equipment. Both resulting in a more reliable water supply
Replace raw water pipeline.	Recommends cleaning, inspection of air releases valves and operating at higher pressures to restore capacity.	New raw water pipeline with capacity to one-half the ultimate WTP capacity. Provides right-of-way to add a second pipeline in the future when the system requires expansion	Addresses the unknown structural condition of the existing raw water pipeline, provides more reliability and capacity for expansion of the water supply system. Also provides some excess capacity for industrial raw water sales in the interim thus increasing system revenue.
Replace New Boston Road WTP	Recommends new membrane filters, repairs to existing flocculation/sedimentation basins and chemical feed equipment.	Recommends a new water treatment plant on a new site with room to expand the plant to 60 mgd.	The new water treatment plant will have a modern treatment process that can efficiently address the past water quality concerns from the New Boston Road WTP and meet current and projected water quality rules. The new plant site allows for expansion to promote growth in Northeast Texas.
RWRD Water Transmission Pipeline	Recommends replacement of high service pumps	Recommends new pumping facilities along with a reconfiguration of the RWRD Member City Transmission Pipeline	Provides an expandable pump station to meet growth in the system. Isolates the RWRD Member City System from the Texarkana Water Utilities water distribution system offering more energy efficient operation and better metering of water use by the members.

Project Funding Options

There are a number of possible funding options for proposed improvements. Historically utilities have sold revenue bonds that are supported by revenues from future rates. The estimated annual debt service assuming a 30 year finance period and a four percent interest rate is $6,000,000. Additionally there are a number of funding vehicles available from the Texas Water Development Board that could reduce the annual costs of financing the system. These vehicles include:

- Drinking Water State Revolving Fund – a loan program that allows communities to take advantage of the State credit rating.
- State Participation Program – a program where the State finances a project. The payments for future capacity are deferred and owned by the State until the capacity is needed by future growth.
- Water Infrastructure Fund – Subsidized and deferred funding for water supply projects

Next Steps

This report provides the RWRD with basic information necessary to decide whether or not to proceed with developing a new water supply system to replace the aging Member City System. To proceed, the RWRD needs to establish a basis to finance the project. That basis will require contracts with the member cities to purchase water at a fixed rate basis. With water supply contracts in hand, RWRD can then secure funding to begin development of the project.

Section 1
Introduction

1.1 Background

The water supply system that has become known as the Member City System was constructed in the 1960s. This Member City System includes a raw water intake and pump station on Lake Wright Patman, the New Boston Road Water Treatment Plant, a raw water pipeline that conveys water from the lake to the water treatment plant, and a Member City Pipeline that delivers treated water to the various member cities. The system is operated by Texarkana Water Utilities for the benefit of the member cities that include Texarkana, Texas, Avery, Annona, Dekalb, Hooks, Maud, Nash, New Boston, Red River Redevelopment Authority (TexAmericas Center), Red Water and Wake Village.

The Riverbend Water Resources District (RWRD) was created by the Texas Legislature in 2009 to provide more governance for the group that had become known as the "Member Cities". These member cities (listed above) are the beneficiaries of the water supply from the water supply system known as the Member City System. RWRD is authorized to provide water supply and potentially other services to its member cities and possibly other entities in Bowie County, Texas and surrounding counties.

The RWRD Member City System was constructed in the 1960s and has served the community well for the past 50 years, but many components are in need of replacement. Specific concerns that the new system is intended to address include:

- Plan for a water supply that will support projected increases in both municipal water use and industrial water use from projected growth in the Northeast Texas area.
- Lake Wright Patman is a relatively shallow lake and the raw water intake for the RWRD Member City System is located at an elevation of 210 feet mean sea level (msl). The intake experiences vortices and diminished capacity when the lake level drops below 220 feet msl a condition that occurs with some frequency. An intake system should be planned to take advantage of more of the usable volume of Lake Wright Patman to assure water supplies through a severe drought and provide the Member Cities access to their full permitted water right.
- The raw water pump station is 50 years old and in need of replacement. The pumping equipment and the pump station structure should be compatible with the improvements to the raw water intake so that the two components can work as a system to assure a reliable water supply through a severe drought.
- The raw water pipeline between the raw water pump station and the New Boston Road Water Treatment Plant will not support a plant capacity in excess of 20 million gallons per day (mgd). The Phase 2 study identified an initial water treatment plant capacity of 20 mgd and an ultimate capacity of 60 mgd. The raw water transmission pipeline capacity to support the water treatment plant will likely be constructed in phases, but the initial phase should at a minimum reliably support the initial water treatment plant capacity plus an expansion to 30 mgd.
- The New Boston Road Water Treatment Plant, with a current capacity of 20 mgd, is 50 years old. Much of its equipment is in need of replacement and was designed with treatment processes that

do not meet current regulatory guidelines. The configuration of the plant makes a thorough renovation unfeasible and does not allow sufficient area to add treatment capacity.

- The existing water treatment process does not adequately address the taste and odor issues that result from algae blooms in Lake Wright Patman. Disinfection by-products and maintenance of disinfection residuals have also been concerns that need to be addressed. The Phase 2 study recommended replacing the existing New Boston Road Water Treatment Plant with a new 20 mgd plant, but did not specify a specific site.
- The existing RWRD Member City Water Transmission System appears to be in acceptable condition, but some remote segments will need additional capacity as additional members or customers are added to the system.

Texarkana Water Utilities operates the Member City System for the benefit of the Member Cities, Texarkana, Texas, Avery, Annona, Dekalb, Hooks, Maud, Nash, New Boston, Red River Redevelopment Authority (TexAmericas Center), Red Water and Wake Village. Texarkana Water Utilities also operates the water distribution system for Texarkana, Texas and Texarkana, Arkansas and a separate water supply system that draws water from Millwood Lake in Arkansas. The Millwood system includes a raw water intake in Millwood Lake, and a water treatment plant known as the Millwood Water Treatment Plant. While Texarkana, Texas and Texarkana, Arkansas are both beneficiaries of the Millwood water supplies, the remaining member cities are not currently authorized by contract or law to benefit from Millwood water supplies. Therefore the focus of this report is limited to improving the water supply from Lake Wright Patman. It is recommended that the Millwood supply and the Lake Wright Patman supply both be maintained in a sustainable condition to assure a reliable long term water supply for the region.

1.2 Purpose & Scope of Study

This study was commissioned by the RWRD to identify a potential new water treatment plant site and a raw water intake site on Lake Wright Patman. The study also presents the costs of developing a new 20 mgd water treatment plant and raw water intake system to replace the system that has become known as the Member City System. The study was funded in part by a grant from the Texas Water Development Board and in part by the RWRD.

This study identifies improvements to the “RWRD Member City System” that will assure a long term water supply to the members of the Riverbend Water Resources District. The existing “RWRD Member City System” is defined as the Lake Wright Patman Raw Water Intake and Pump Station, the raw water transmission pipeline between the raw water pump station and the water treatment plant, the New Boston Road Water Treatment Plant and the RWRD Member City Water Transmission System. The scope of the study is limited to the RWRD Member City System.

This study is the third phase of studies commissioned by the RWRD relating to its future water supply. The Phase 2 Study recommended that RWRD construct a new 20 mgd (expandable to 60 mgd) water treatment plant.[4] The recommended plant is to use a treatment process consisting of coagulation, clarification, ozonation, and biological filtration. The Phase 2 Study also recommended that the

[4] CH2MHILL and MTG Engineers and Surveyors, Riverbend Water Resources District Water Supply System Phase 2 Study, XXX

Riverbend Water Resources District construct a new raw water intake in a deeper area of Lake Wright Patman.

The objectives of the Phase 3 Study are:

1) Identify a specific location for the new raw water intake and pump station, develop a conceptual layout for the facilities, quantify land requirements, determine support facility needs such as access and power, and identify permit requirements for the new facility.

2) Identify a specific site for the new water treatment plant, validate the conceptual process design assumptions, develop a conceptual site plan, quantify land requirements, determine support facility needs such as access and power, and identify permit requirements for the new facility.

3) Identify a preliminary raw water transmission pipeline route that connects the raw water pump station to the water treatment plant and identify permit requirements for the new pipeline.

4) Identify a preliminary treated water transmission pipeline route from the new water treatment plant to the existing RWRD Member City Water Transmission System; develop conceptual site plan for finished water storage system, high service pumping system, metering system and connection to the RWRD Member City System and identify permit requirements for the new facilities.

5) Complete a hydraulic analysis of the transmission system to the Member Cities Water Transmission System to determine if any sections need replacement or enhancements to provide sufficient capacity to supply Member Cities and any potential future customer cities.

Section 2
Existing RWRD Member City Water Supply System

2.1 Lake Wright Patman Raw Water Intake and Pump Station

The existing Lake Wright Patman Raw Water Intake is located in the northeast quadrant of Lake Wright Patman. Figure 2-01 illustrates the location of the existing raw water intake and raw water pump station. Figure 2-02 illustrates a profile of the existing raw water intake conduit between the intake and the pump station[5]. According to the original plans for the intake and pump station, the raw water intake conduit extends approximately 250 feet into the lake from the raw water pump station. The raw water conduit is a double barrel box with each chamber measuring 5 feet wide by 5.25 feet and set at a flow line elevation of 210.0 feet mean sea level (msl). A channel was excavated at an elevation of 207 feet msl with a 20 foot bottom width and 3 to 1 side slopes from the end of the conduit for a distance of 200 feet.

Lake Wright Patman operates according to a “Rule Curve” that dictates that the conservation pool of the reservoir vary seasonally. The conservation pool is defined as the maximum daily operating level for the reservoir. Water stored above the conservation pool is considered to be stored in the “Flood Pool” and should be released from the reservoir as soon as practical without causing damage downstream. During normal operations, the actual water level in the reservoir will drop below the conservation pool as water is used from the water supply storage pool. From November to April the conservation pool is set at 220.6 feet NVGD. Between April 1 and June 1 the conservation pool is allowed to increase to 227.5 feet NVGD and then between June 1 and October 1 the conservation pool is lowered slowly to 221.2 feet NDVG and then back to 220.6 feet NVDG on November 1.[6]

As noted above, the intake conduit is shown in original plans to be set at a flow line elevation of 210 feet msl with an internal height of 5.25 feet making the top of the intake at an elevation of 215.25 feet msl. This elevation is only 5.35 feet below the minimum conservation pool elevation. If the level of Lake Wright Patman drops significantly below the minimum conservation pool of 220.6 feet msl, the intake will begin to experience a phenomenon called vortexing where whirlpools form above the intake and introduce air into the intake pipe. The introduction of air into the intake system interferes with the normal operation of the intake conduit and the pumps. As the lake level drops closer to the intake elevation, the vortexing phenomenon is exacerbated to a point that the system capacity is diminished. The vortexing phenomenon has been reported to occur on numerous occasions in the recent past.

The solution to the vortexing issue is to maintain a higher lake elevation or lower the intake. Raising the conservation pool of Lake Wright Patman has been suggested as an alternative to increase water supplies in Northeast Texas, but doing so would not be the ultimate solution to the intake vortexing. The implementation of a higher conservation pool does not assure the lake levels will not drop to the critical levels in the future during a drought thus leaving the water supply system short of capacity at its most vulnerable period.

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[5] Freese and Nichols; Texarkana Water Works Improvements, Lake Texarkana Pump Station Vicinity Map and Miscellaneous Details; April 1957.
[6] Freese & Nichols; System Operation Assessment of Lake Wright Patman and Jim Chapman; January 2003

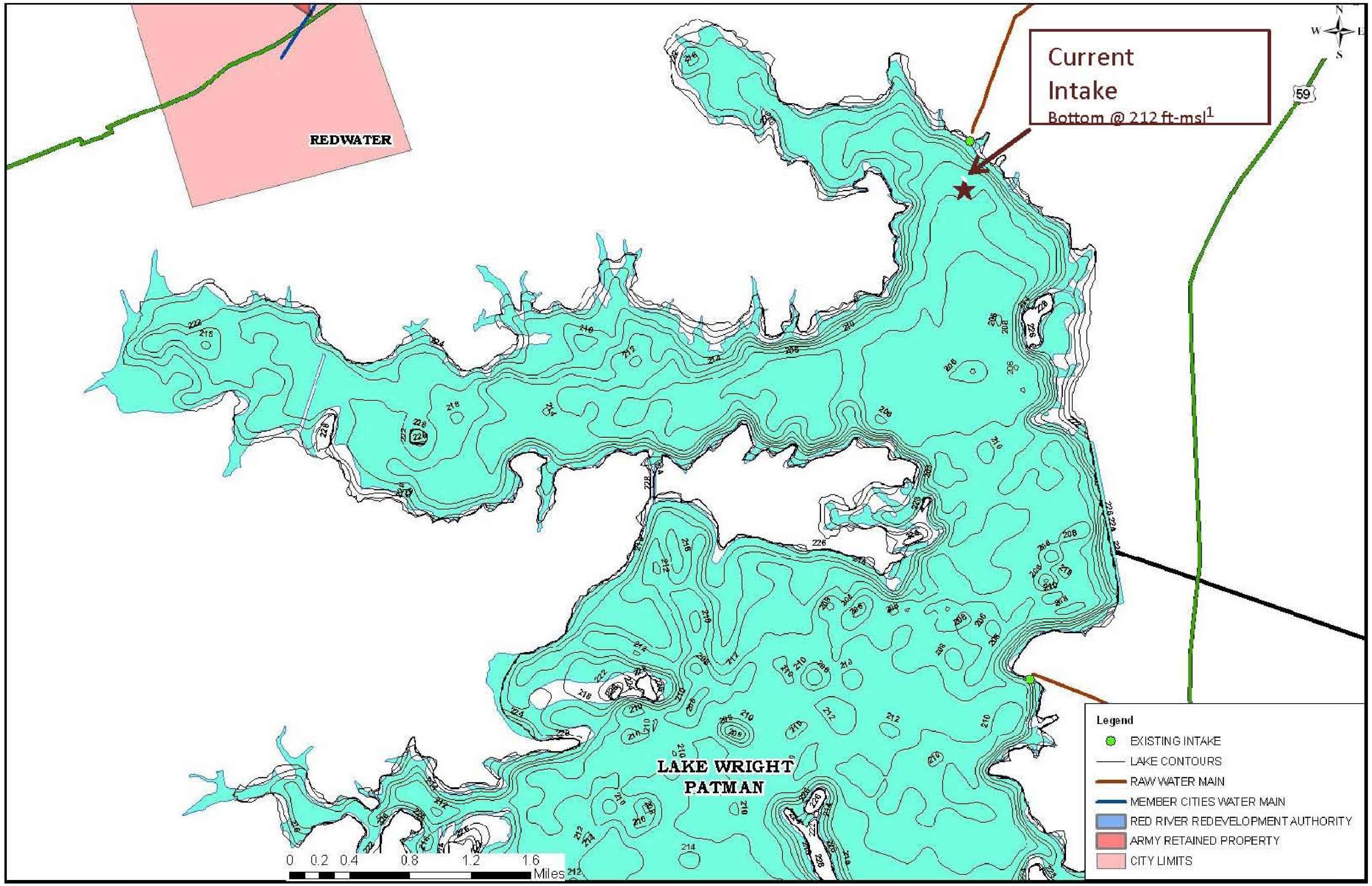

FIGURE 2-01
EXISTING INTAKE
AND PUMP STATION LOCATION

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Extending the current intake to a deeper elevation is also not feasible. Such an extension would require 3000 feet of pipe. Even with such an extension, the existing conduit with its elevation of 210 feet msl will still limit operating level of the lake to the 216 feet to 217 feet msl levels leaving a significant quantity of water in the lake inaccessible to Member Cities.

The most feasible solution is to identify an intake location with deeper water near the shore so that a system can be installed that can take advantage of a larger volume of water in Lake Wright Patman and be less susceptible to future siltation.

2.2 Raw Water Transmission Pipeline

The existing raw water transmission pipeline conveys raw water under pressure from the raw water pump station to the New Boston Road Water Treatment Plant. The pipeline is a 33-in. diameter pretensioned concrete cylinder pipe that extends slightly over 9 miles. The pressure class of the pipe varies from 100 pounds per square inch (psi) near the water treatment plant to 150 psi near the raw water pump station. The pipeline was designed for a capacity of 24.5 mgd using a Hazen-Williams “C” fiction factor of 130. Recent tests indicate a “C” factor of approximately 93 and a capacity of 19.6 mgd.[7]

The Engineering firm of HDR suggested the capacity of the system could be increased to as much as 25 mgd and possibly 30 mgd by changing the raw water pumps and cleaning and inspecting the pipeline.[8] These conclusions were apparently drawn without the benefit of any internal inspection or testing of the existing pipeline to determine if the “C” value could be significantly increased and maintained at a higher value. These assumptions should be verified by field test to actually determine if the pipeline structure is sufficiently sound to withstand the higher pressures that result from operating at the higher flow rates.

Given the age, capacity and condition of the existing pipeline as described in the HDR study it is reasonable to assume that the existing pipeline should not be considered as a long term component of the future RWRD Member City System. However, the pipeline might be considered as an alternative for a short term component provided inspections and testing validates its condition.

2.3 New Boston Road Water Treatment Plant

The New Boston Road Water Treatment Plant is located on New Boston Rd. (U.S. 82) approximately 2 miles east of U.S. 59. Figure 2-03 illustrates the location of the New Boston Road Water Treatment Plant. The plant was constructed in the 1950’s with a capacity of 18 mgd using conventional flocculation/sedimentation/granular media filtration. The last major upgrade to the facilities was completed in the 1970’s. The current water treatment process has approached, but not exceeded, regulatory water quality requirements by periodically exhibiting high filtered water turbidities and disinfection by-product concentrations that approach regulatory limits.[9] Additionally water treatment from the New Boston Road Plant is reported to exhibit unpleasant tastes and odors.

[7] HDR Engineering, Inc.; Evaluation of Lake Wright Patman Regional Water Facilities; June, 2010
[8] HDR Engineering, Inc.; June 2010
[9] HDR Engineering, Inc.; June 2010

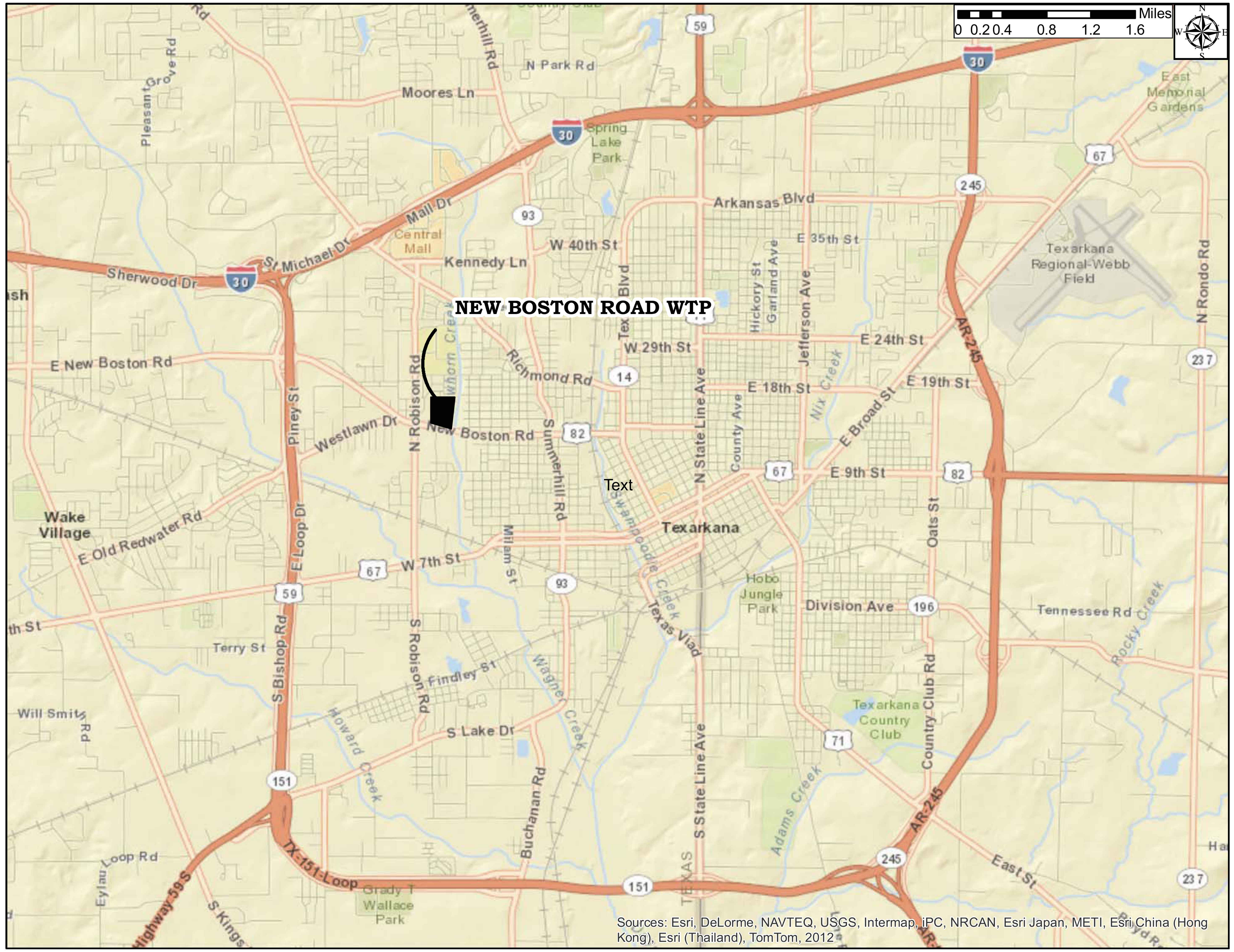

FIGURE 2-03
VICINITY MAP
NEW BOSTON ROAD WTP

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Many of the physical facilities at the New Boston Road Water Treatment Plant are from the original construction in the 1950's or from the expansion in the 1970's.[10] A visual inspection of the plant revealed that much of this equipment as well as the treatment structures are in a deteriorated condition. Structures, including the sedimentation basins exhibit deteriorating concrete, cracks and leakage. The filter complex valves and piping are also in a state of deterioration and configured in such a way that the entire water treatment plant would have to be shut down for an extended period of time to implement significant improvements.

The New Boston Road Water Treatment Plant site is severely constrained by floodplain issues. Much of the existing plant is located within the floodway of floodplain as shown in Figure 2-04. Any renovation or expansion on this plant site will need to address these issues.

In summary, the existing New Boston Road Water Treatment Plant is in need of replacement. Regulatory changes require improved finished water quality that is difficult to obtain from the current treatment processes. In addition, the condition of the structures and equipment are in such a state of deterioration that replacement, either on the existing site with floodplain mitigation or on a new site, is the only feasible option.

2.4 RWRD Member City Treated Water Transmission Pipeline

The RWRD Member City Treated Water Transmission Main extends from the New Boston Road Water Treatment Plant westward along New Boston Road (U.S. 82) to Annona. The RWRD Member City Treated Water Transmission System also includes two spurs that extends south from New Boston Road through the Red River Army Depot and serves Maud and Redwater. The New Boston Road pipeline varies in size from 33-inches in diameter at the New Boston Road Water Treatment Plant to 10-inch in diameter beyond De Kalb. The New Boston Road pipeline between the New Boston Road Water Treatment Plant and FM 2253 where it connects with a Texarkana Water Utilities water distribution main is an integral part of the Texarkana Water Utilities water distribution system. Beyond FM 2253, the New Boston Road Transmission Main serves the other Member Cities exclusively.

The delivery point for each RWRD Member City, except Texarkana Water Utilities, includes a meter and a ground storage tank. Water is discharged into the top of the tank creating an "air gap" thus protecting the system from backflow contamination.

The RWRD Member City Water Transmission System is reported to be in good condition and to have sufficient capacity to meet the near term needs of the Member Cities. If the system is expanded to add more members, the capacity of the will need to be evaluated to assure that it will continue to deliver the desired quantity of water to all customers.

[10] HDR Engineering, Inc.; June 2010

Section 3
Project Requirements

3.1 General Requirements

This study focuses on improvements to the member city system that includes the raw water intake and pump station in Lake Wright Patman, the New Boston Road Water Treatment Plant, the raw water pipeline that conveys water from the raw water pump station to the New Boston Road Water Treatment Plant and the treated water transmission pipeline that conveys treated water to the various member cities. The Millwood Lake Water Supply System is a critical component of the water supply for Texarkana, Texas and Texarkana, Arkansas and will continue play a key role in the future water supply for the region, but for the sake of reliability, flexibility, operational efficiency and the viability of the water supply to support growth, the region should maintain both the Member City (Lake Wright Patman) and the Millwood Lake water supplies in a reliable and sustainable condition..

The proposed Member City system should be planned to provide a cost effective, reliable and sustainable water supply for all of the Member Cities. The system should be expandable so that it can supply the projected growth for the Member Cities and that of any new members or customers that join the system.

3.2 Capacity Requirements

The proposed system should be planned with sufficient capacity to meet the current and near term (next 10 to 15 years) needs of the Member Cities and have sufficient residual capacity to supply any unexpected growth. Yet the system should not be “over built” to the point that it becomes a financial burden on the Member Cities. The system should also have the flexibility to potentially serve new industrial customers with raw or partially treated water should there be a need for such water.

This study focus on planning for a system with an ultimate capacity of 60 mgd which will meet the needs of an equivalent population of 200,000, assuming a per capita consumption of 150 gallons per capita per day and a 2 to 1 peaking factor. The term equivalent population is defined as total consumption for all classes (municipal, industrial, and commercial) divided by the total population. The equivalent population can appear inflated in areas with high commercial and/or industrial users and areas with high university student populations.

The baseline initial capacity of the system will be planned for 20 mgd, but alternative, with costs, will be presented for 25 mgd and 35 mgd.

3.3 Water Quality Requirements

The proposed system should be planned to meet the current and reasonably anticipated Federal and State Drinking Water rules. As noted in Section 2, the existing New Boston Road Water Treatment Plant has experienced issues with disinfection by-products and high filter turbidities in the past. This plant was designed to meet different treatment requirements than those now required by the regulatory agencies. Water from the plant has also been reported to lose disinfectant residuals at some RWRD Member City delivery points. In addition, the water treatment process should be planned to address the taste and odor issues that have historically plagued the existing New Boston Road Water Treatment Plant. These issues should be specifically addressed in the water treatment process planning. Specific regulatory limits and treatment goals for the new plant for select water quality parameters of particular interest are shown in Table 3-01.

Table 3-01 Key Water quality Parameters

Parameter	Regulation	Goal
Turbidity	< 0.3 NTU 90% of time	< 0.15 NTU 95% of time
TTHM	80 ug/L	60 ug/L
HAA5	60 ug/L	45 ug/L
TOC	Typically 40% removal	35-50% removal
Color	15 cu	10 cu
MIB/Geosmin	NA	< 10 ng/L

Section 4
Water Quality Goals and Process Recommendations

4.1 Previous Water Quality Evaluations

2010 HDR Engineering Studies - In 2010, HDR Engineering completed a study on what is required to upgrade the existing New Boston Road WTP to meet current and future water quality goals. The treated water quality goals stated in the study were turbidities less than 0.2 NTU 95% of the time, total organic carbon (TOC) removal of between 35% and 50% depending on raw water TOC and alkalinity, total trihalomethanes of less than 60 ug/L and haloacetic acids of less than 45 ug/L. In addition, objectionable taste and odor is to be mitigated by reducing MIB and Geosmin to less than 10 ug/L in the finished water. Raw water characteristics were measured by HDR during a 1 year period from May 2006 to April 2007. The water was found to contain high levels of organic matter in the water as illustrated by the high levels of TOC. Turbidity was variable but typical of a reservoir surface water source. Alkalinity was moderate but trended toward the low side during certain times of the year. Levels of MIB and Geosmin were found to be as high as 100 ng/L and 3,100 ng/L respectively indicating very high levels of objectionable taste and odor. Selected water quality results from that study are shown in Table 4-01.[11]

Table 4-01 –Raw Water Characteristics

Date	Turbidity	pH	TOC	Alkalinity
May 06	16.9	7.7	10.0	75
June 06	9.6	7.6	9.7	74
July 06	0.9	7.2	10.4	76
Aug 06	12.1	8.0	11.6	78
Sep 06	12.1	7.4	11.3	82
Oct 06	10.8	7.4	11.5	82
Nov 06	11.4	7.6	8.2	82
Dec 06	14.4	7.7	8.7	84
Jan 07	16.6	7.2	7.5	78
Feb 07	19.6	7.2	NA	NA
Mar 07	18.0	7.3	7.1	48
Apr 07	19.8	7.4	9.0	50

The HDR report recommended that the existing clarifiers be replaced with incline plate settlers due to the poor condition of the existing sedimentation basins. The existing filters would be replaced with low pressure membranes to improve turbidity and pathogen removal. Free chlorine was recommended for primary disinfection and in conjunction with the disinfection credits provided by the membranes the chlorine contact time should be able to be kept short enough to not exceed the total trihalomethane or haloacetic acid goals. An on-site chlorine generation system was recommended due to the hazards associated with the use of chlorine gas and the general trend in the industry to move to safer alternatives. Taste and odor would be controlled with the use of Powdered Activated Carbon (PAC) and chlorine dioxide. Other facilities at the existing plant would continue to be used.[12]

[11] HDR Engineering, Inc.; June 2010
[12] HDR Engineering, Inc.; June 2010

There was no mention of a pilot study of the membrane system on Lake Wright-Patman water provided in the report. Likewise, no results on the effectiveness of MIB and Geosmin removal with Chlorine Dioxide and PAC were provided. To remove MIB and Geosmin from a level of up to 3100 ng/L down to below 10 ng/l would require a 99.67% removal. This is an extremely high level of removal and it is doubtful any single treatment technology would be able to deliver it. This is especially true for some adsorption technologies such as PAC or technologies with lower levels of oxidation capacity such as potassium permanganate or chlorine dioxide. The use of granular activated carbon (GAC) or UV oxidation are typically much more effective for taste and odor control but are considerably more expensive. The other technology used for taste and odor control, particularly in North Texas, is ozone. The use of ozone was not evaluated in the HDR report.

Riverbend Water Resources District Phase 2 Studies The other previous study was the Phase 2 report completed by CH2M HILL and MTG Engineers in December, 2009.[13] This report analyzed seven different process trains for the treatment of Lake Wright Patman water including combinations of various clarification technologies, biologically activated carbon filtration, membranes, granular activated carbon, ozonation, UV advanced oxidation, and the current conventional treatment process. The alternatives were evaluated on anticipated effectiveness and life cycle cost for a completely new treatment facility of various sizes between 20 and 35 mgd. The primary goals of the treatment process was the removal of turbidity and organic matter that leads to disinfection by-product formation, color in the water, and taste and odor issues. Table 4-02 summarizes the anticipated capital and annual unit water costs (operating cost plus amortized capital cost) for each of the seven options investigated at a 20 mgd capacity along with a summary of the benefits as determined in the Phase 2 report.

Table 4-02–Anticipated Cost of Water

Option	Capital Cost ($M)	Annual Unit Water Cost ($/1000 gal)	Benefit Summary
1. PAC-Enhanced coagulation-Ozone-BAC filters	54.5	1.14	Excellent Taste and Odor removal, Excellent TOC removal, Good pathogen removal/inactivation.
2. PAC-Enhanced Coagulation-MF/UF-UV/AOP	89.7	2.39	Excellent Taste and Odor removal, Excellent TOC removal, Excellent pathogen removal/inactivation.
3. PAC-Enhanced coagulation-MF/UF - GAC	89.1	2.33	Moderate Taste and Odor removal, Good TOC removal, and Good pathogen removal/inactivation.
4. PAC-Enhanced Coagulation-Ozone-BAC (Actiflo)	49.5	1.08	Excellent Taste and Odor removal, Excellent TOC removal, Good pathogen removal/inactivation.
5. PAC-Enhanced Coagulation-Ozone-BAC (Super P)	54.8	1.14	Excellent Taste and Odor removal, Excellent TOC removal, Good pathogen removal/inactivation.

[13] CH2MHILL and MTG Engineers and Surveyors, Riverbend Water Resources District Water Supply System Phase 2 Study, XXX

Option	Capital Cost ($M)	Annual Unit Water Cost ($/1000 gal)	Benefit Summary
6. PAC-Enhanced Coagulation-Ozone-BAC (Solids Contact)	56.2	1.17	Excellent Taste and Odor removal, Excellent TOC removal, Good pathogen removal/inactivation.
7. PAC-Enhanced Coagulation-Media Filtration (Existing)	45.5	1.03	Poor Taste and Odor removal, Moderate TOC removal, Moderate pathogen removal/inactivation.

As a result of this evaluation, a process of PAC, Enhanced coagulation (with the Actiflo process), ozonation, and biological filtration was proposed for the new treatment facility (Option 4). Powdered activated carbon would be added at the new intake to assist the ozone and biological filters with taste and odor removal during peak taste and odor episodes. Ozone and biologically activated carbon filtration provide a powerful combination for the removal of the high levels of organic carbon and taste and odor compounds found in Wright Patman water.[14] The recommended alternative (Alternative 4) provides the District with tremendous water quality benefits over the lowest cost option (Option 7) at a premium of only about 10% above the capital cost and less than 5% in annual unit water cost of Option 7.

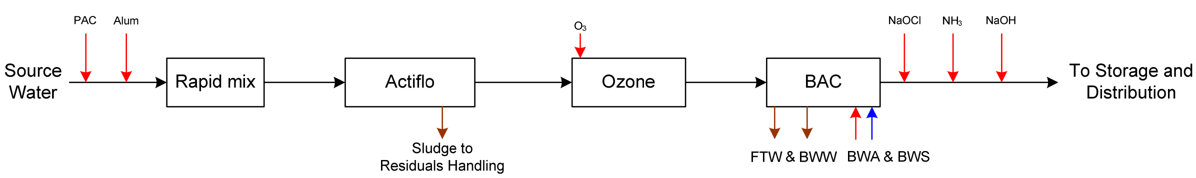
4.2 Treated Water Quality Goals for the Riverbend Water Supply System

As discussed in Section 3 of this report, the proposed system should be planned to meet the current and reasonably anticipated Federal and State Drinking Water rules. As noted in Section 2, the existing New Boston Road Water Treatment Plant has experienced issues with disinfection by-products and high filter turbidities in the past. Water from the plant has also been reported to lose chloramine residuals at some RWRD Member City delivery points. In addition, the water treatment process should be planned to address the taste and odor issues that have historically plagued the existing New Boston Road Water Treatment Plant. These issues should be specifically addressed in the water treatment process planning.

4.3 Water Treatment Process Recommendations for the Riverbend Water Supply system

The treatment process selected in the Phase 2 study is shown in Figure 4-01. As summarized in the previous section of this report, the process was selected based on a cost-benefit analysis using Decision Science techniques.

Figure 4-01



[14] CH2MHILL and MTG Engineers and Surveyors; Riverbend Water Resource District Phase 2 Water Supply Study; December 2009

These unit processes include ozonation and biologically active carbon filters (BAC). Both of these processes have been successfully applied in waters with characteristics similar to that found in Lake Wright Patman to address taste & odor concerns, high disinfection by-product concentrations and concerns with maintaining disinfection residuals. Enhanced coagulation coupled with ozonation and BAC is a proven multi-barrier process to remove total organic carbon (TOC) a precursor to disinfection by-products. Ozonation coupled with BAC is also a proven process to remove taste & odor compounds to levels below human perception thresholds and to produce water with a stable disinfection residual. In summary, the recommended process is believed to be capable of producing a water quality that meets the objectives of Riverbend Water Resources District, but this hypothesis should be validated by laboratory testing of the process conceptual design.

The purpose of the concept validation portion of this Phase 3 Study is to verify the suitability of the treatment process selected in the Phase 2 Study and to obtain preliminary chemical feed rates and expected performance. Additional testing will be conducted during final design to confirm performance during other times of the year or different raw water quality. The testing consisted of the following tasks:

- Task 1 Raw Water Characteristics
- Task 2 Clarification Optimization
- Task 2A Impact of pH Adjustment
- Task 3 Ozonation Evaluation

4.4 Lake Wright Patman Raw Water Quality

Wright Patman water is typically high in organics (TOC ranges from 5 to 13 mg/L) and is subject to seasonal taste and odor events from the algae related compounds Methylisoborneol (MIB) and Geosmin. High levels of iron and manganese have also been reported in the raw water supply during certain times of the year. Texarkana Water Utilities Staff report that monitoring of Wright Patman water for Cryptosporidium under the requirements of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) has shown very little Cryptosporidium in the raw water and that the District has been placed in compliance Bin 1. This bin requires no additional treatment for Cryptosporidium beyond conventional treatment and is important because placement in a higher bin could have required more advanced treatment processes such as membranes or UV to be used to meet regulations. The plant will be configured such that such advanced processes can be added in the future should water quality changes or new regulations require them.

Typical water quality issues experienced at the existing New Boston Road Water Treatment Plant include high disinfection by-product formation, taste and odor issues, seasonal iron and manganese episodes, high color levels, and a difficulty in maintaining a chloramine residual.

Task 4-03 shows the result of the portion of the process validation study that quantifies the raw water quality found in Lake Wright Patman. The results of analyses of two raw water samples taken from Lake Wright Patman on June 2, 2011 and August 11, 2011 are presented.

The water was found to contain high levels of organics with color and Total Organic Carbon (TOC) prevalent. The organic loading makes the water susceptible to disinfection-by-product formation during chlorination. Specific UV Adsorbance (SUVA) is often used as a surrogate for by-product formation potential and is calculated by dividing the UV-254 absorbance by the amount of Dissolved Organic Carbon (DOC). SUVA levels above 2 indicate a high potential for by-product formation. The Lake Wright Patman sample has a raw water SUVA value of 2.98. The alkalinity was found to be moderate to low indicating a moderate level of buffering capacity in the water against pH change. Turbidity was found to be moderate for a lake source of supply. Dissolved solids were low. The results compared favorably to previous analyses conducted on Lake Wright Patman water. Both samples were dry weather samples.

Table 4-03 – Raw Water Characterization

Metals Analysis		06-02-11	08-11-11
Fe, total	ug/L	146	452
Fe, dissolved	ug/L	---	<100
Mn, total	ug/L	---	124
Mn, dissolved	ug/L	---	0.51
Hardness	mg/L as $CaCO_3$	---	76.1

General Chemistry Analysis		06-02-11	08-11-11
Alkalinity	mg/L as $CaCO_3$	65.8	81.6
Ammonia	mg/L as N	---	<0.10
Bromide	mg/L	0.10	0.059
Color, apparent	units	---	70
Color, true	units	---	15
pH	units	9.04	8.37
TDS	mg/L	---	148
Turbidity	ntu	5.5	15.5
Geosmin	ng/L	30.4	3.9
MIB	ng/L	10.8	11.3
TOC	mg/L	7.34	9.16
DOC	mg/L	---	8.68
UV-254, filtered	abs $*cm^{-1}$	---	0.1630
UV-254, unfiltered	abs $*cm^{-1}$	---	0.2581
SUVA (UV-F, DOC)	L/mg-m	----	1.88

4.5 Water Treatment Process Validation

Clarification Optimization **-** The purpose of this task was to evaluate various chemical coagulants and determine which one is most effective for the removal of turbidity, color, Total Organic Carbon (TOC), and iron and manganese from Lake Wright Patman water and to determine the recommended dose. Three coagulants were analyzed – Aluminum Sulfate (Alum), Ferric Sulfate, and Polyaluminum Chloride. Each coagulant was tested on the Lake Wright Patman water at 6 different dosages to determine its effectiveness for turbidity removal, TOC removal, color removal, iron removal, manganese removal, and impact on SUVA. Goals for the clarification process were to reduce TOC levels by 40% to comply with Texas Commission on Environmental Quality (TCEQ) regulations, to reduce apparent color to below 10 color units, and to produce a settled water turbidity of less than 1 NTU.

Alum Evaluation – Results of the jar tests using alum showed good turbidity removal with a dose of about 45 mg/l required to achieve the settled water turbidity goal of 1 NTU. TOC removal, however, required a much higher dose with 40% removal not occurring until over 60 mg/L of alum had been fed. Color removal was excellent with a dose of about 50 mg/l of alum required to get below 10 color units. Excellent iron and manganese removal occurred with dosages of 30 mg/L or more. Good UV254 absorbance reduction was observed with alum, particularly at the higher dosages. Figures 4-02 through 4-07 show the results of the alum testing.

Figure 4-02

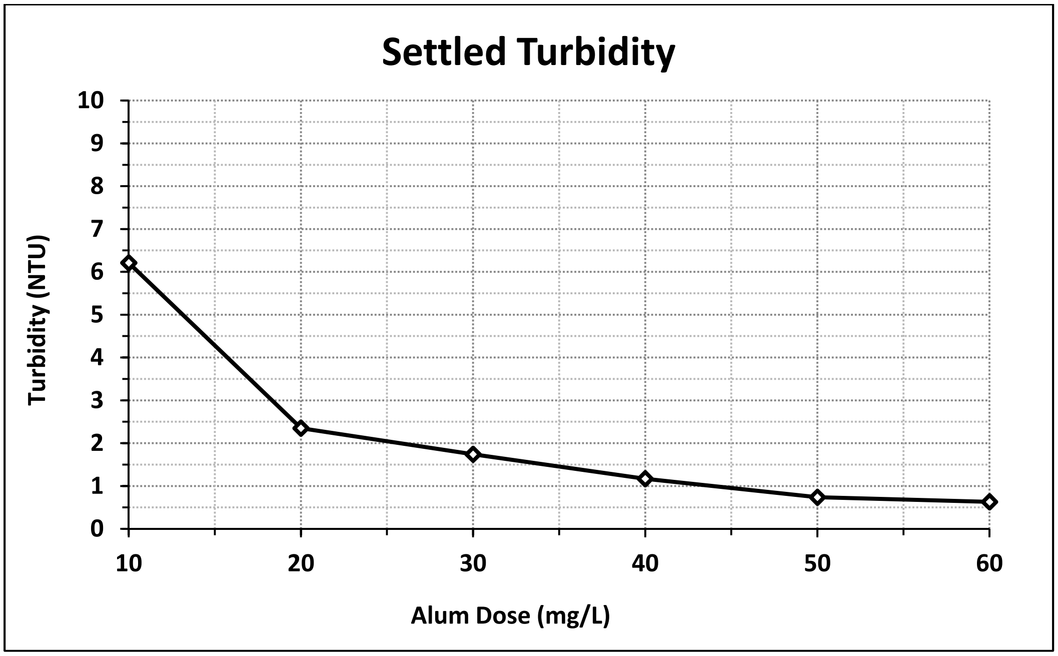


Figure 4-03

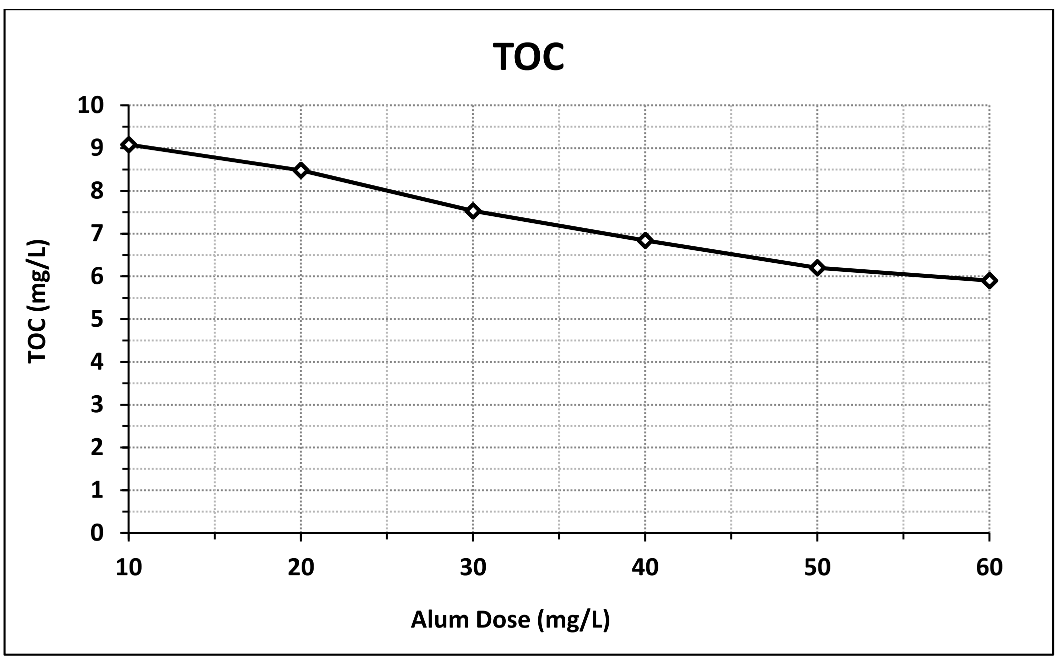


Figure 4-04

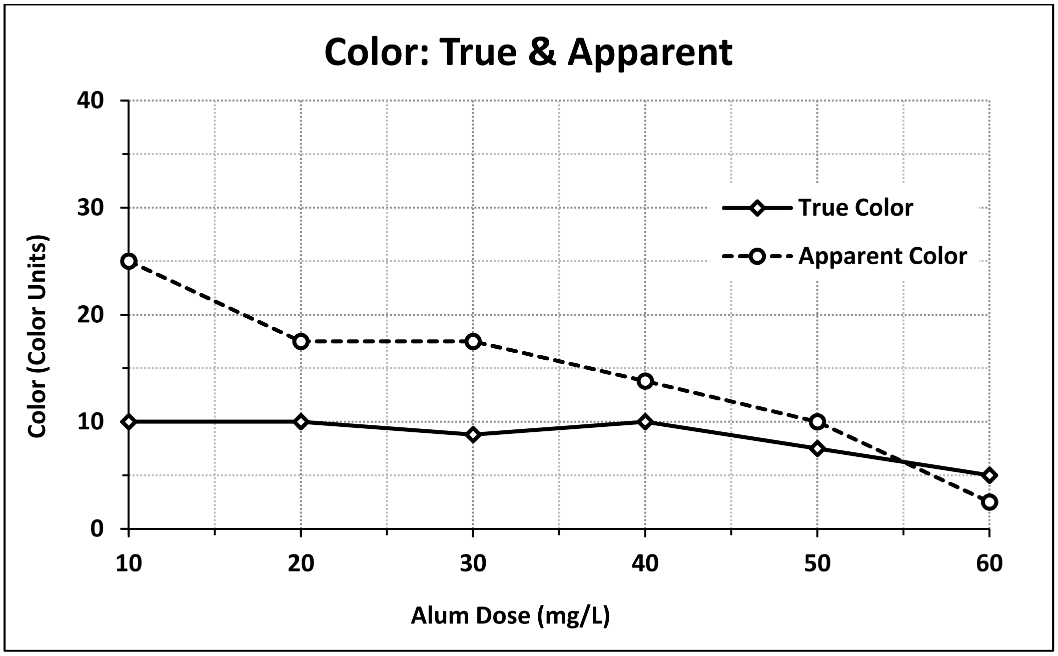


Figure 4-05

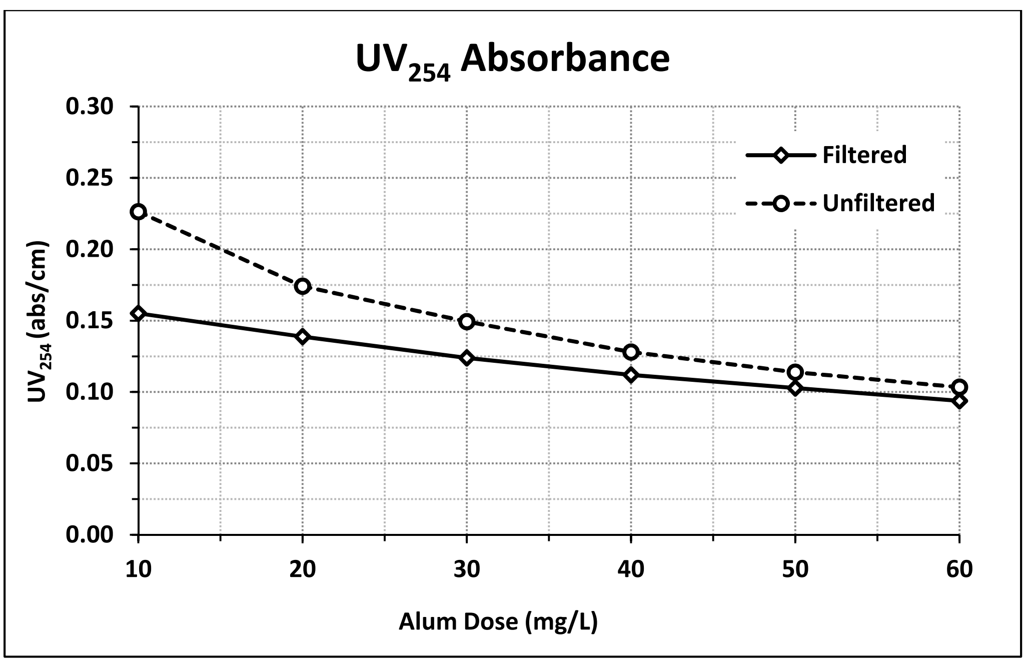


Figure 4-06

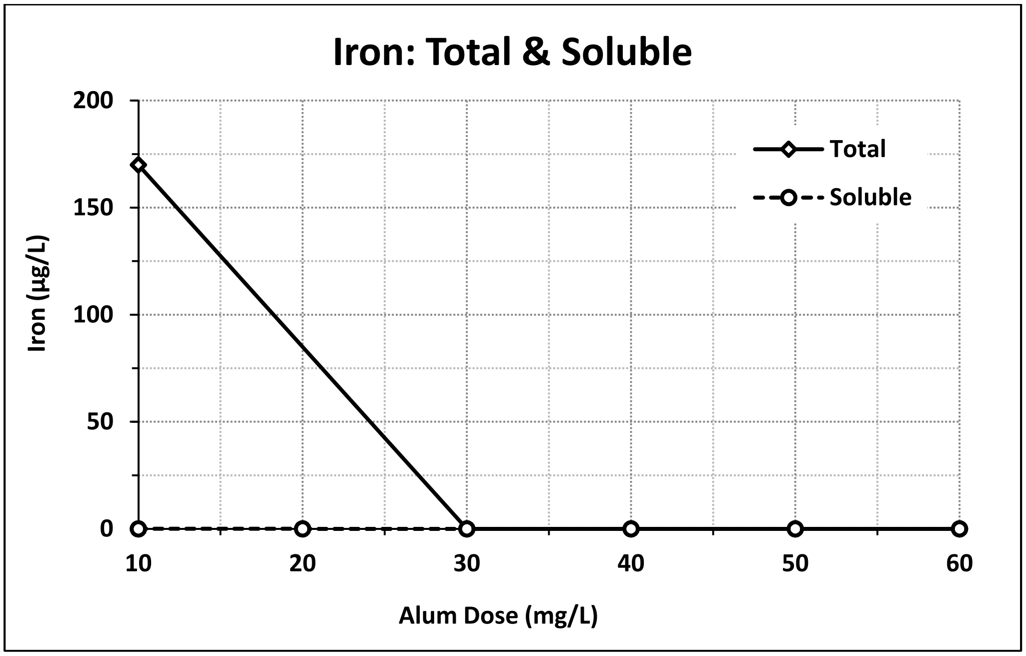
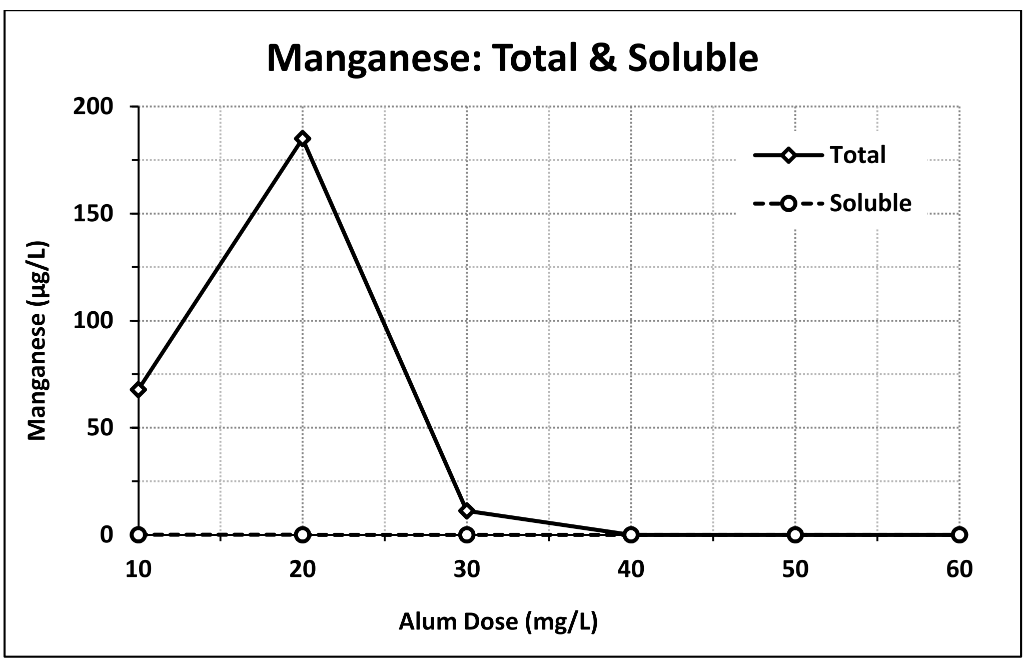


Figure 4-07



Ferric Sulfate Evaluation – Ferric sulfate typically required higher dosages to accomplish the design goals. Turbidity reduction to less than 1 NTU required a dose of 60 mg/L of ferric sulfate (as ferric sulfate) and TOC reduction of 40% required a dose of just over 60 mg/L as well. UV 254 absorbance reduction was similar to alum. Color removal required dosages of well over 60 mg/L to reach 10 color units. Iron and manganese removal with ferric sulfate was poor. Iron levels below 200 ug/L and manganese levels below 20 ug/L were not obtained during the jar testing. Manganese began to resolubalize and additional removal ceased at dosages above 30 mg/L of ferric sulfate. Figures 4-08 through 4-13 show the results of the jar testing using Ferric Sulfate.

Figure 4-08

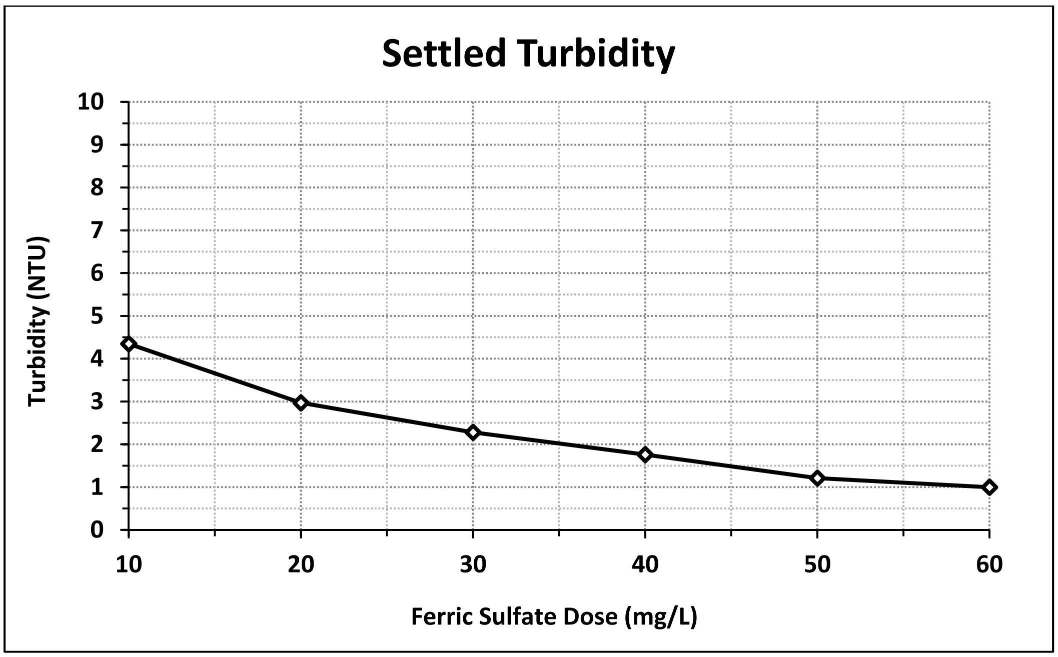


Figure 4-09

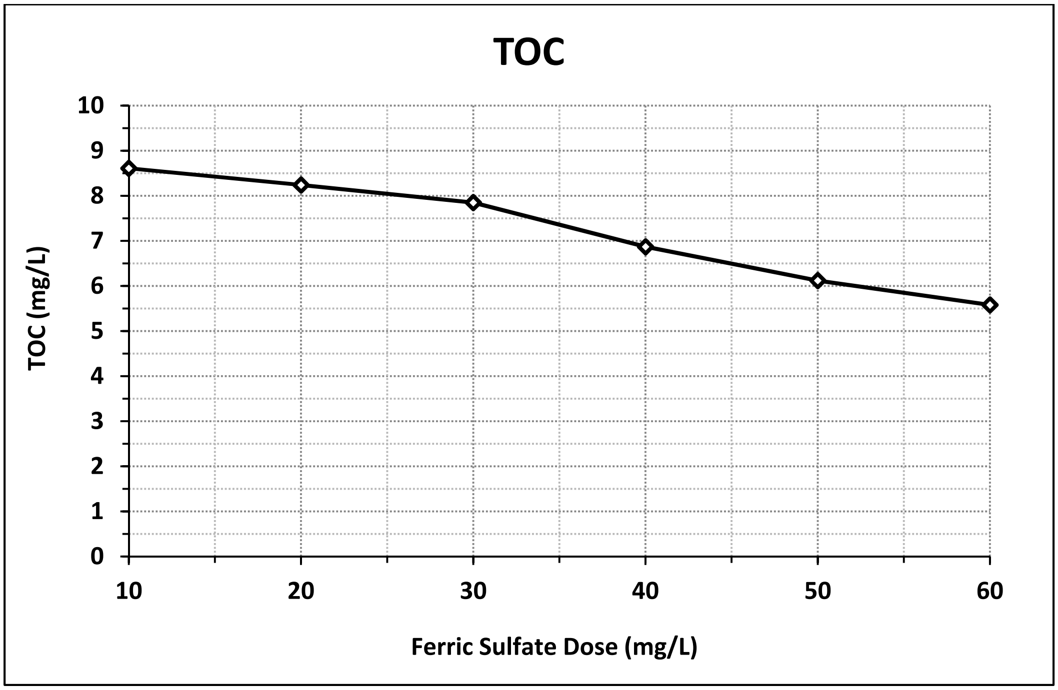


Figure 4-10

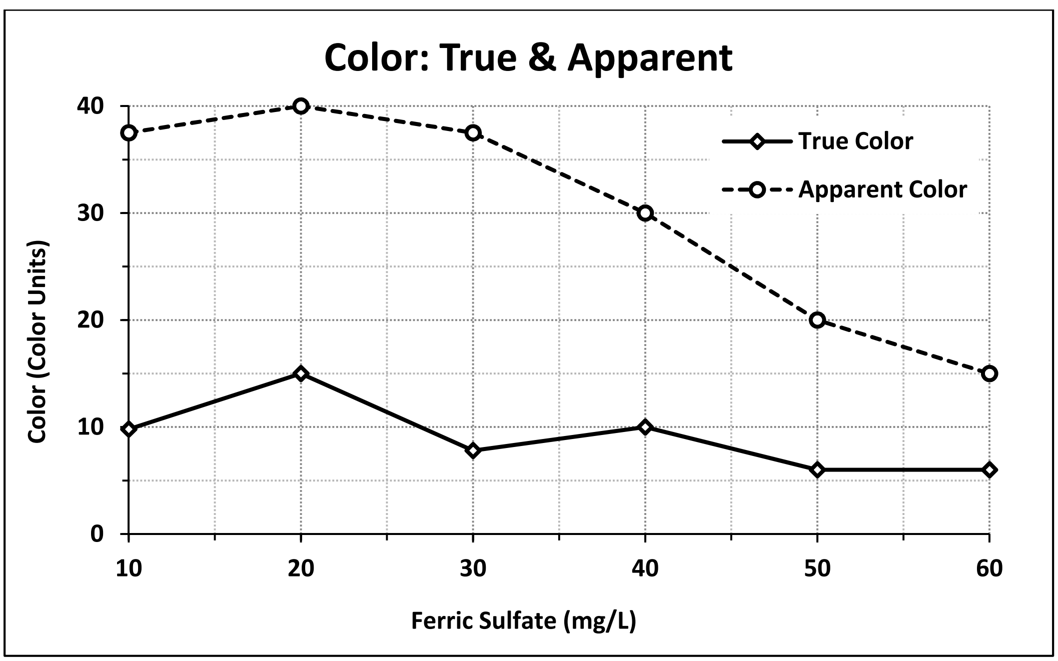


Figure 4-11

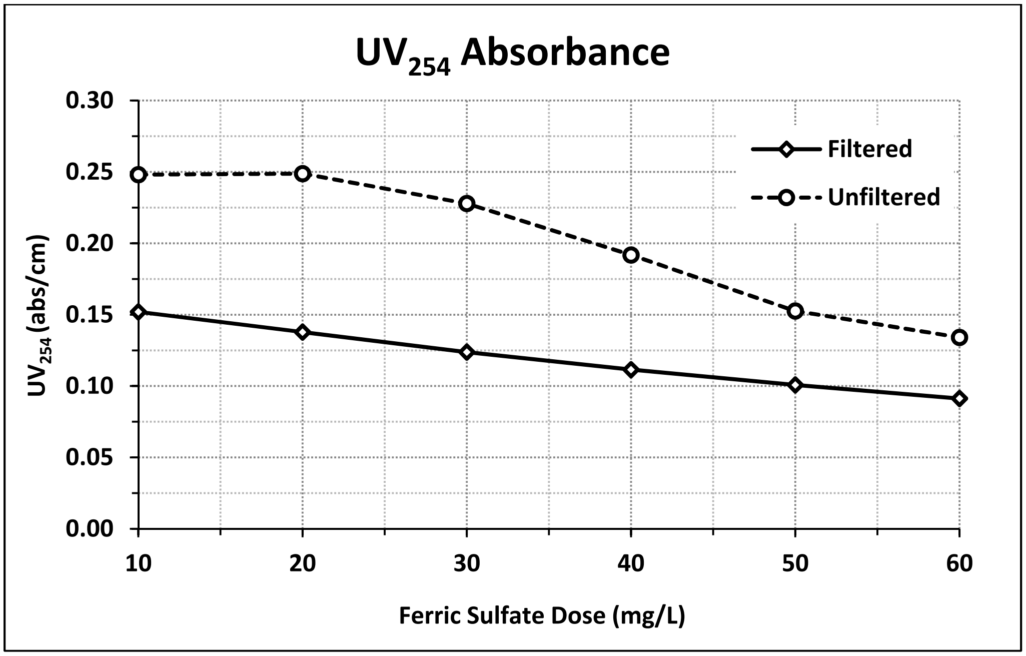


Figure 4-12

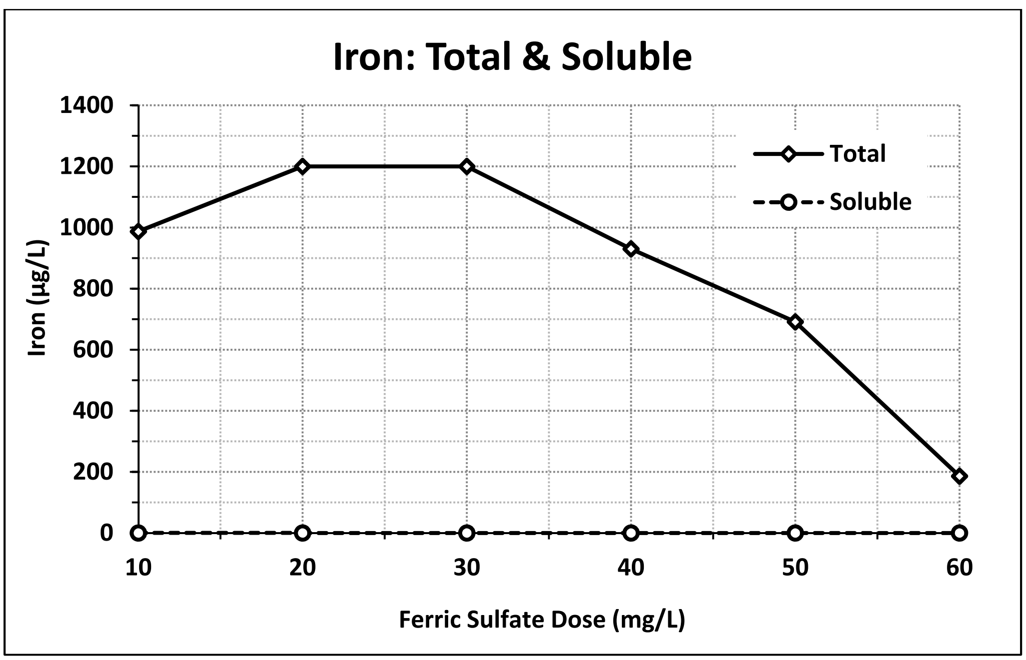
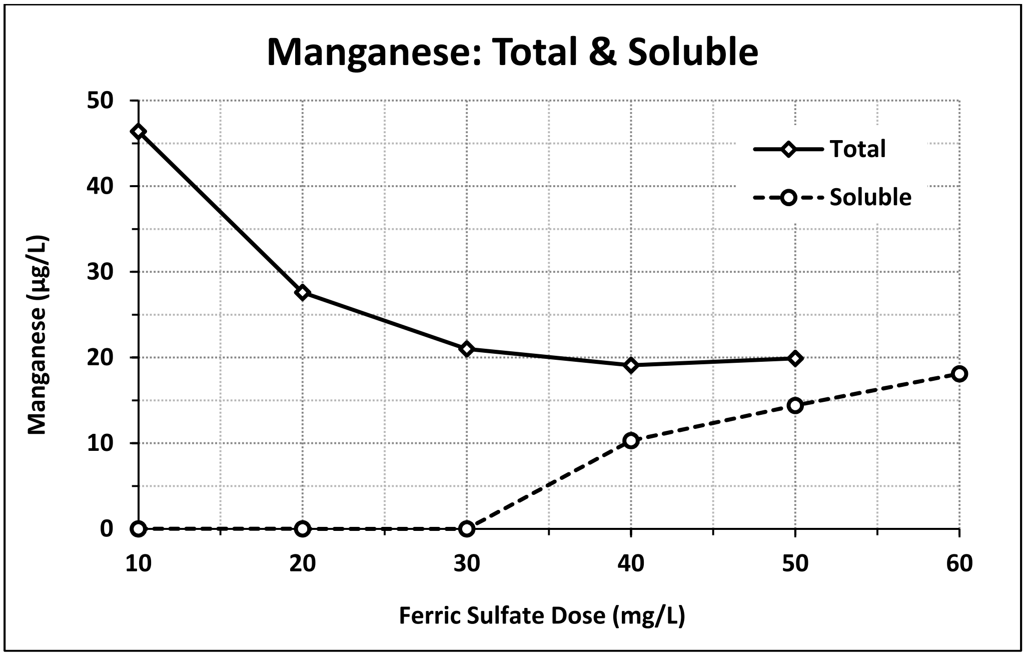


Figure 4-13



Polyaluminum Chloride Evaluation – The polyaluminum chloride (PACL) performance yielded mixed results. Turbidity removal was good with a dose of 35 mg/L required to reach 1 NTU. Organics reduction as measured by both TOC removal and UV254 adsorbance was less than with either alum or ferric sulfate. The jar test was run with a PACL dose of up to 40 mg/L and at the high dose, TOC removal was only 25%, significantly less than the 40% goal. Color removal to 10 color units required just under 40 mg/L of PACL. Iron and manganese removal was good using PACL. The results of the testing using PACL are shown in Figures 4-14 through 4-19.

Figure 4-14

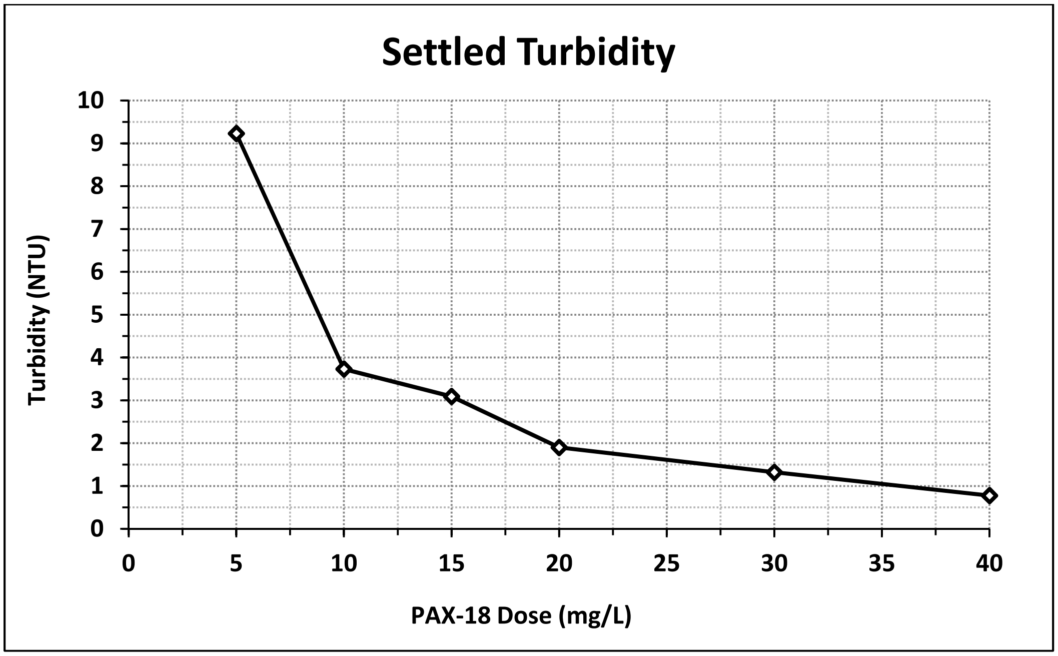


Figure 4-15

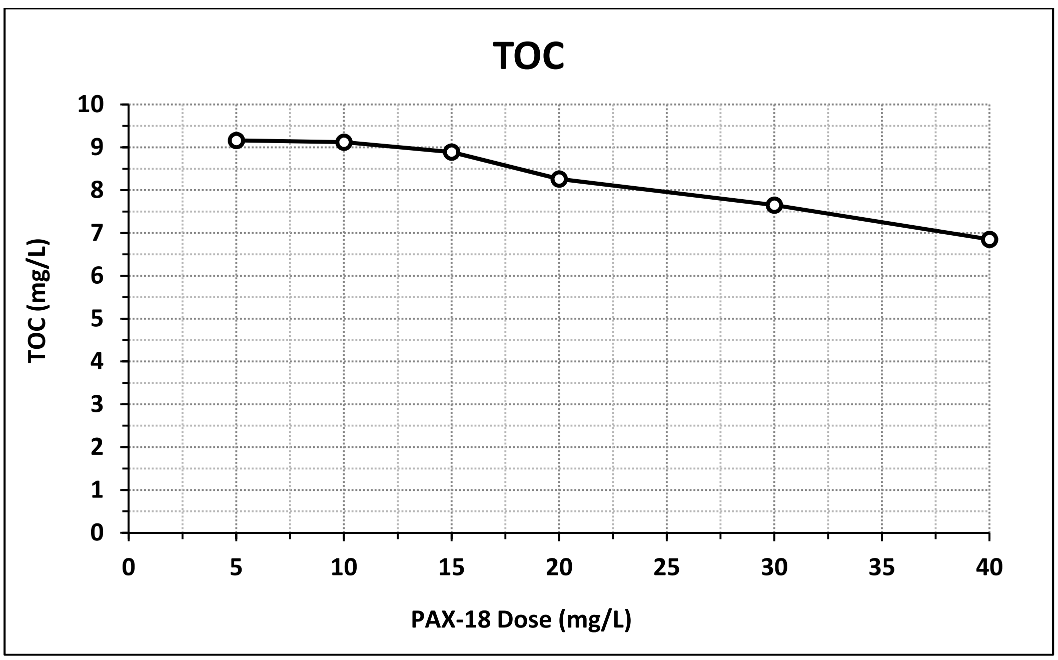


Figure 4-16

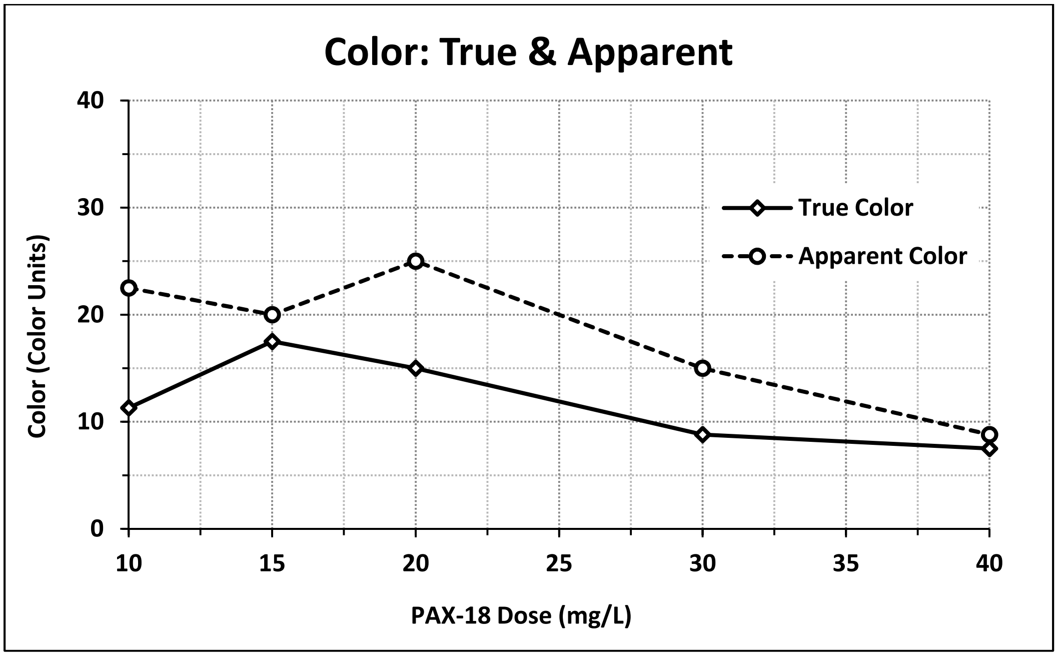


Figure 4-17

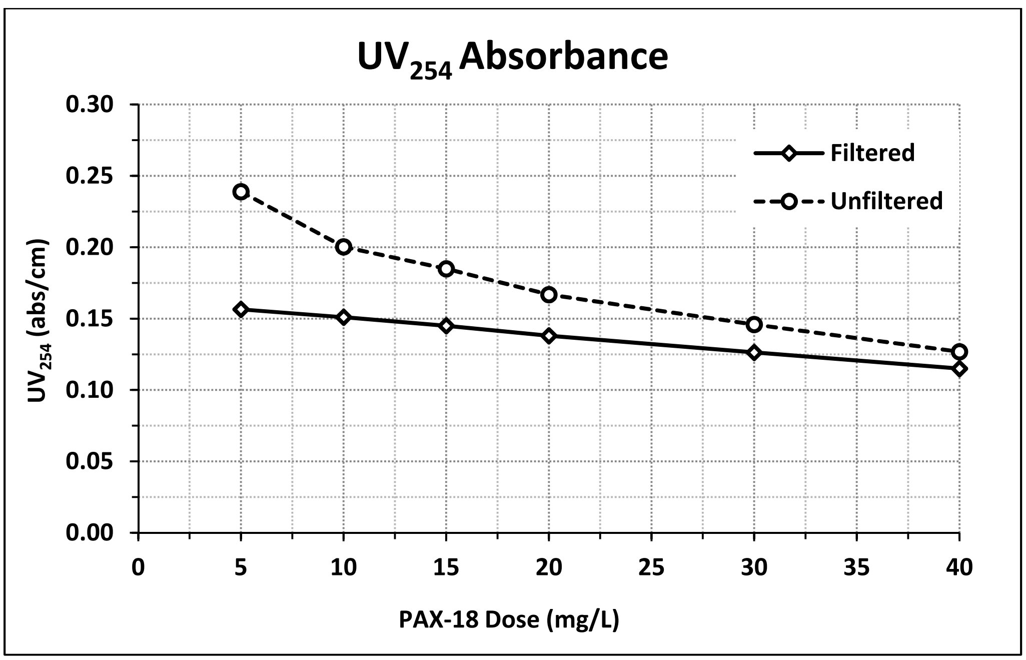


Figure 4-18

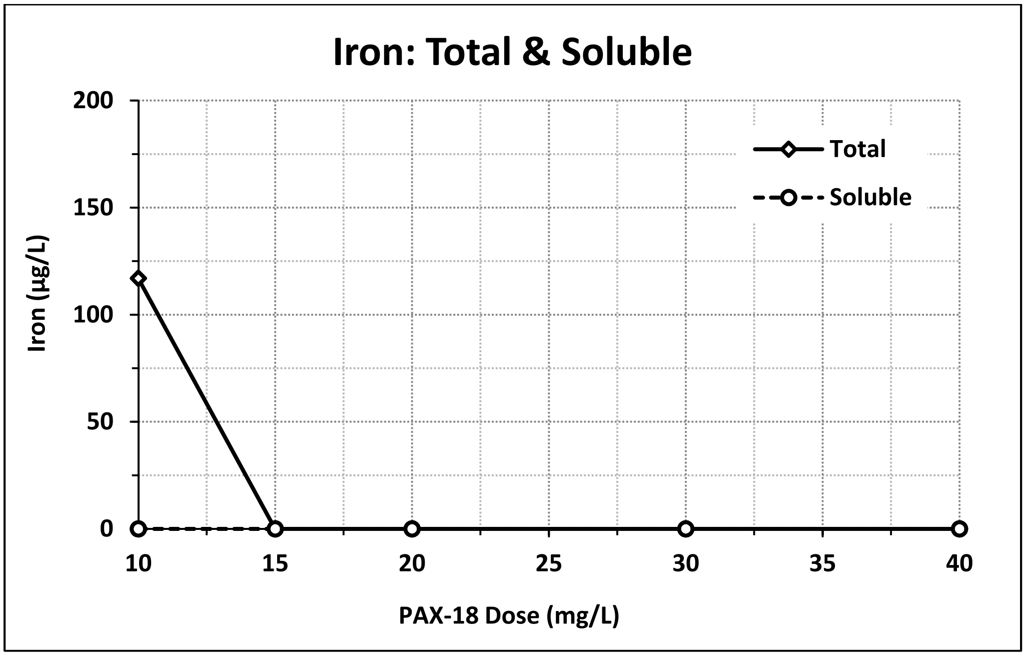
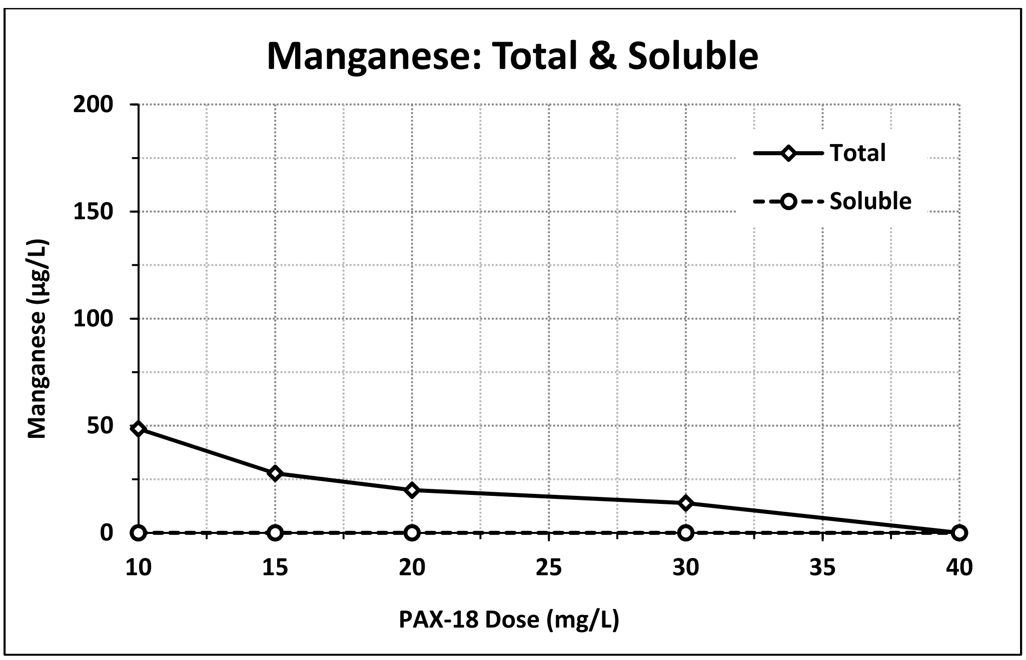


Figure 4-19



Comparing the cost and effectiveness of the various coagulant alternatives it was determined that alum would be used for the next rounds of testing. Alum was selected because it performed best in TOC, color, iron, and manganese removal and had good turbidity removal as well. In addition, alum is used at the current facility treating Lake Wright Patman water so it has proven effective in plant scale operations and the current operators are familiar with its use and a steady supply of chemical is available.

<u>Task 2a – Impact of pH Adjustment</u> – The next step in the clarification optimization was evaluating the impact of pH on coagulation efficiency. Typically, most coagulants perform best for TOC removal at a pH near 6. Since Lake Wright Patman water typically has a pH above 8, sulfuric acid was added to the sample to depress the pH and the jar tests run again using alum as the coagulant. Three jar tests were run and evaluated. The first was the run at a natural pH conducted in Task 2. The second was with the addition of sufficient sulfuric acid to reduce the pH during coagulation to about 7. In the third test, additional acid was added to reduce the pH during coagulation to about 6.5. These samples were then analyzed for turbidity removal, TOC removal, color removal, and UV254. The results are shown in Figures 4-20 through 4-23.

Figure 4-20

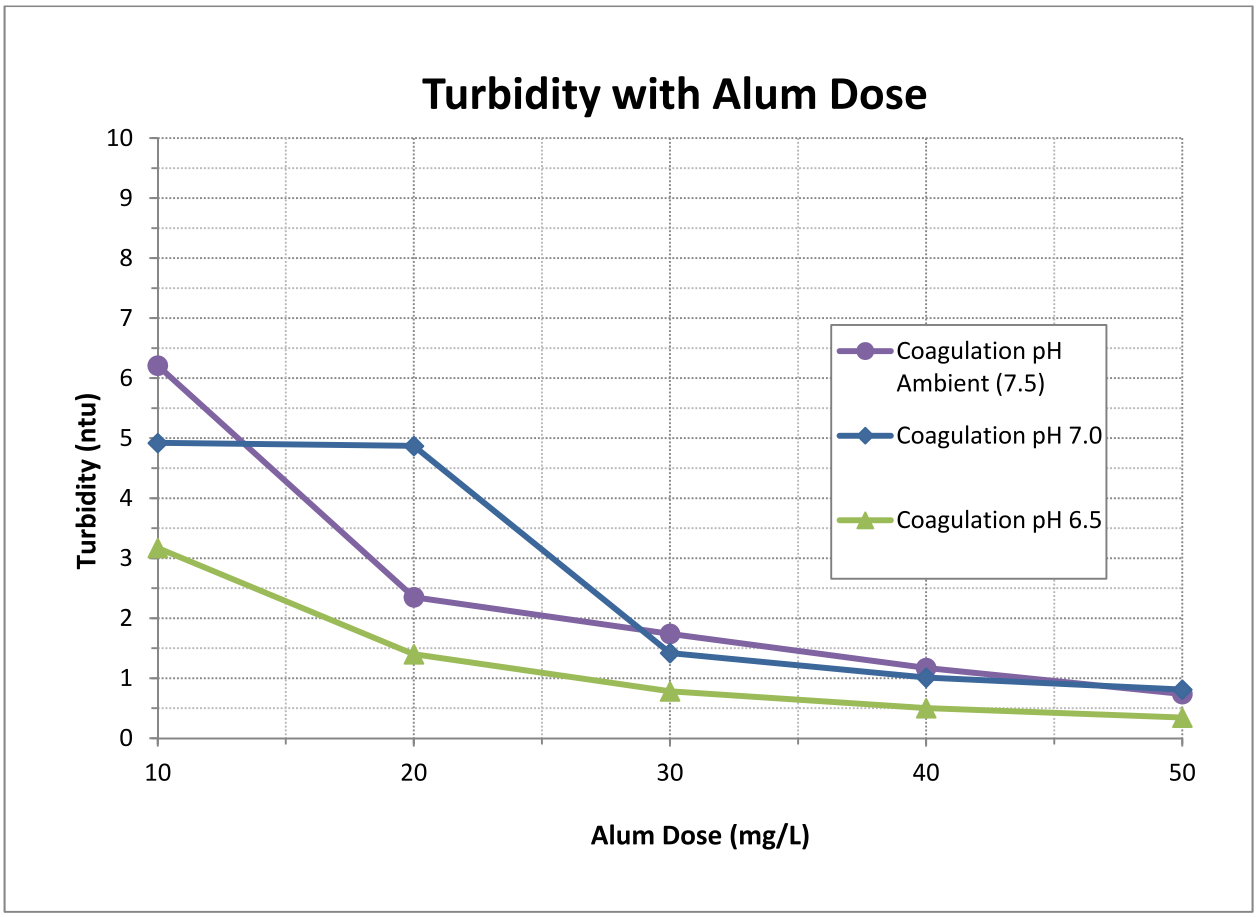


Figure 4-21

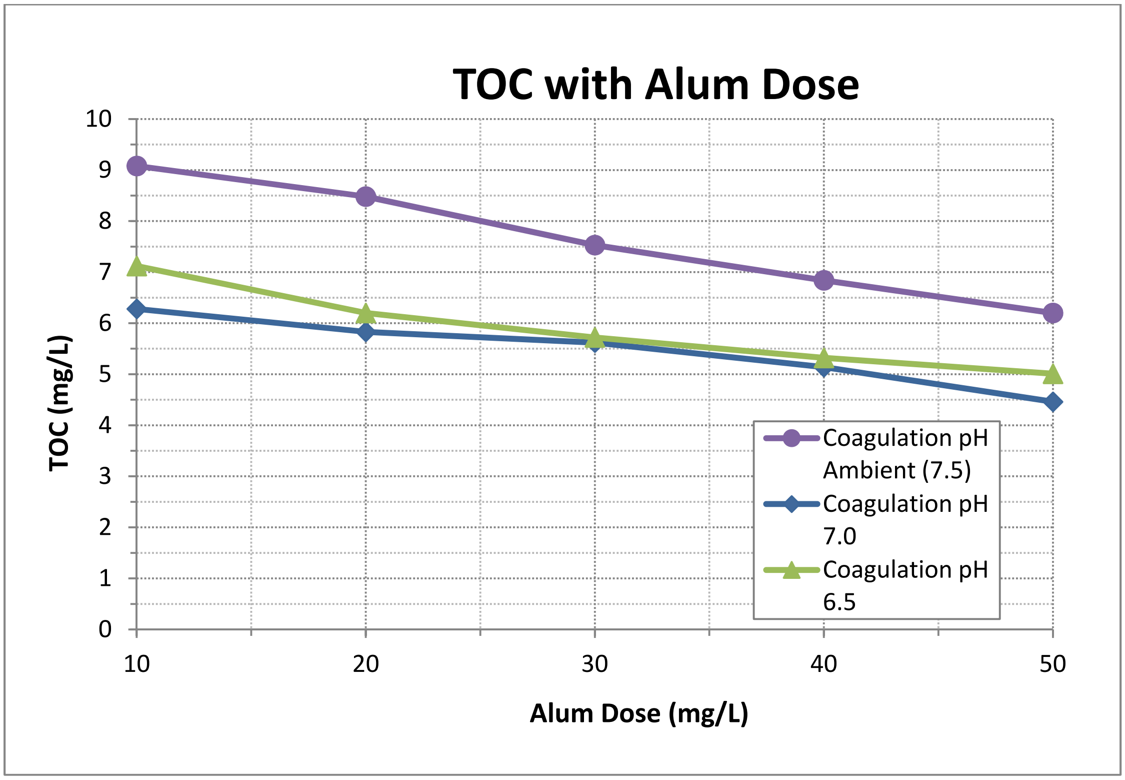


Figure 4-22

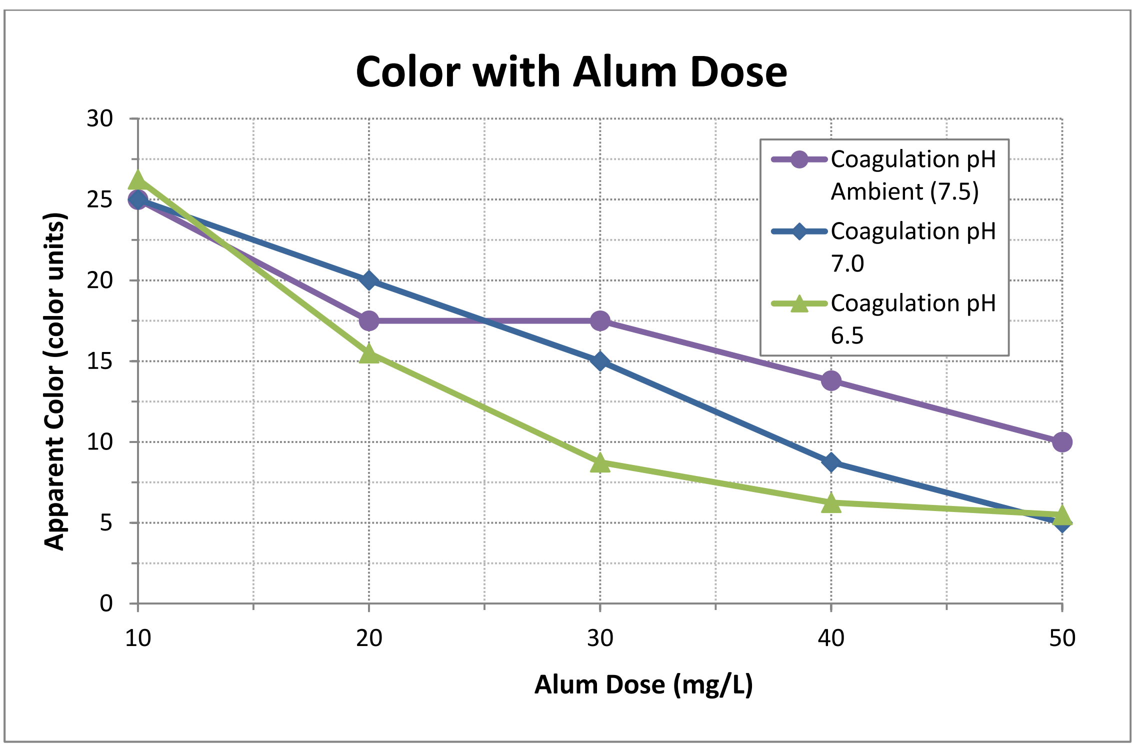
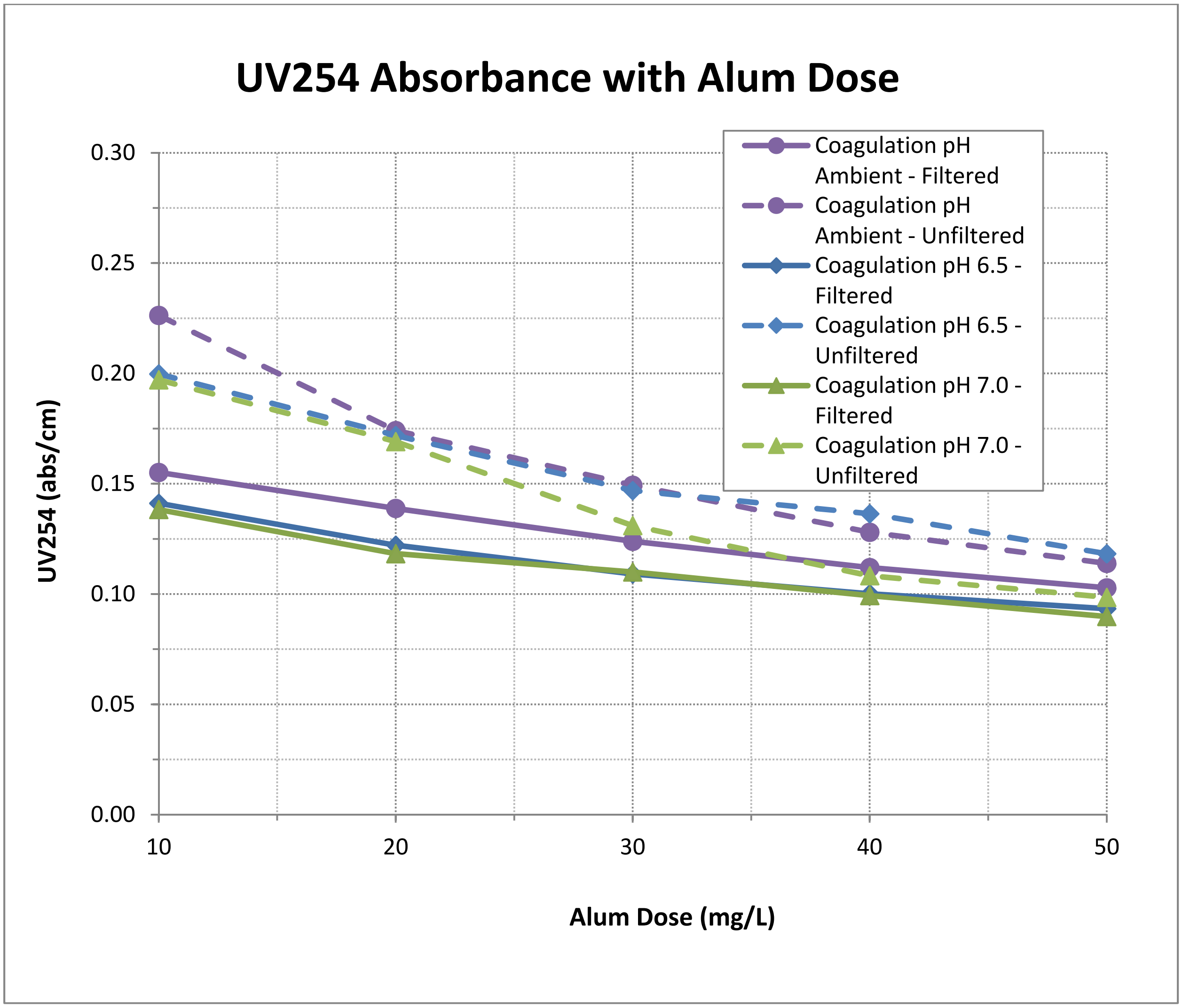


Figure 4-23



This round of testing showed the significant improvements in coagulation efficiency that can be obtained by lowering the pH during coagulation. The alum dose required for 40% removal of TOC dropped from over 60 to about 35 mg/L when the coagulation pH was lowered to 7. Interestingly, no additional improvement in efficiency was noted when the pH was further dropped to 6.5. There was no noticeable difference in turbidity removal between ambient pH and pH 7.0 with both requiring a dose of about 40 mg/l to reach 1 NTU but when the pH was lowered to 6.5 the dose was reduced to about 28 mg/L. Likewise with apparent color removal, the dose required to reach 10 color units in the settled water was reduced from just over 50 mg/L at ambient pH to 38 mg/L at pH 7 and further to 28 mg/L at pH 6.5. During design, an economic evaluation will be performed to summarize the impacts of pH adjustment on treatment efficiency and chemical cost and provide recommendations on chemical dosing.

Task 3 – Ozone Evaluation - The final task in the bench scale testing developed design parameters and checked for disinfection by-product formation associated with the use of ozone in the treatment process. Ozone dose requirements were determined to reach initial ozone residuals of approximately 0.5 and 1.0 mg/L. Ozone demand/decay curves and the decay coefficient were determined for each ozone dose. The impact of pH adjustment was determined by running the tests at both ambient pH and at a coagulation pH of 7.0. The demand and decay curves for each test are shown in Figures 4-24 through 4-27.

These tests show a significant reduction in ozone dose and the decay rate when the pH is lowered from ambient to pH 7. For example, to obtain an initial ozone residual of 0.5 mg/L requires an ozone dose of 4.5 mg/L at ambient pH and the same residual requires a dose of 3.8 mg/L at pH 7. The results for a 1.0 mg/L ozone residual are even more pronounced. A dose of 9 mg/L is required to reach a 1.0 mg/L initial residual at ambient pH but a dose of only 5 mg/L is required at a pH of 7. Further, the decay rate is significantly lower at the lower pH. The initial 1 mg/L ozone residual will decay to 0.1 mg/L (90% decay) after only 3.5 minutes at ambient pH. The same residual will last 6 minutes at a pH of 7. Initial residual and decay rate are essential factors in design of the ozone system for disinfection credit.

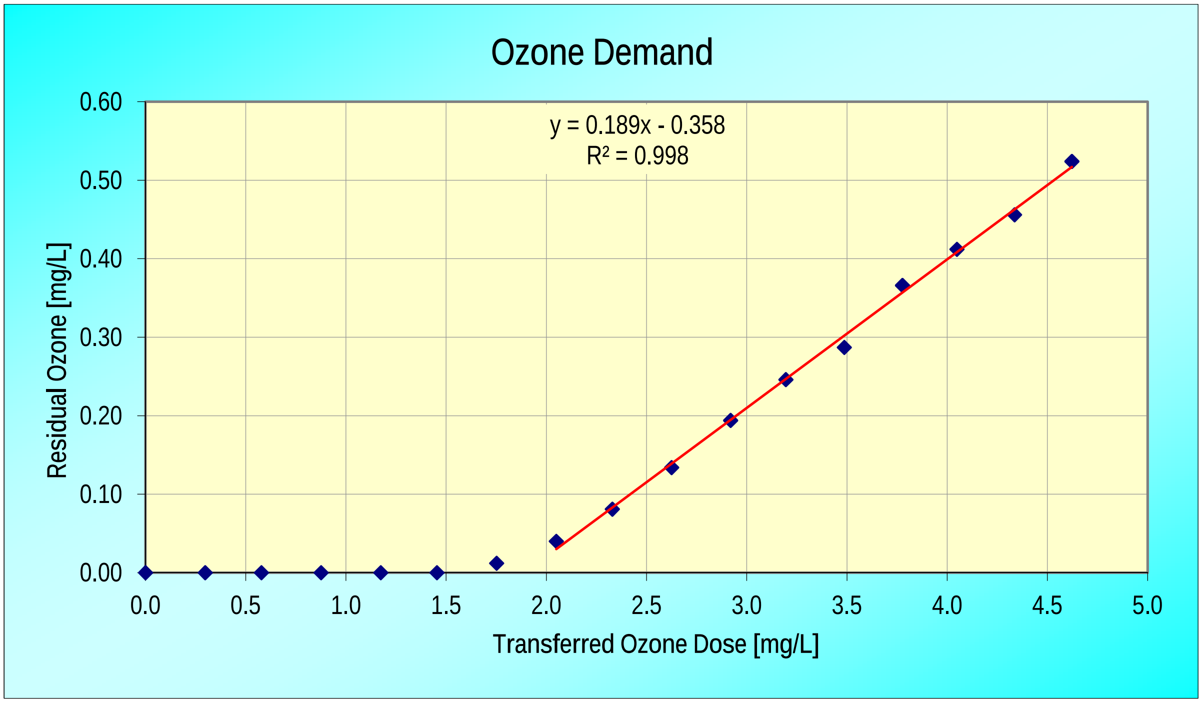
The ozonated samples were tested for Bromate formation which is the primary disinfection by-product associated with the use of ozone. The maximum contaminant level for Bromate is 10 ug/L. Results of the Bromate testing at various ozone dosages after 1 hour of contact time are shown in Table 4-04. Each of the tests show Bromate to be below the maximum limits.

Table 4-04 – Bromate Formation

Ozone Dose(mg/L)	Bromate (ug/L)
4.0	1.3
4.6	2.1
5.3	3.9
9.4	7.8

Following ozonation, a simulated distribution system study was conducted to evaluate disinfection by-product (Trihalomethane (THM)) formation. The test measured THM formation over a 5 day period following the addition of free chlorine. No attempt was made to limit THM formation through the use of chloramines after primary disinfection. A high dose of chlorine (9 mg/L) was required to maintain a free chlorine residual over the 5 day test. The test showed total THM formation of over 200 ug/L after 5 days of contact time. This significantly exceeds the 80 ug/L maximum contaminant level and indicates that disinfection by-product control strategies will be required. This was not unexpected based on previous operating experience on Wright Patman water. The typical control strategy will be the addition of ammonia to form chloramines after a brief free-chlorine contact time. Chloramines quench the further production of THMs. Further bench scale studies incorporating chloramines into the treatment process will be conducted in the next phase of the study.

Figure 4-24 – Initial Residual = 0.5 mg/L, ambient pH



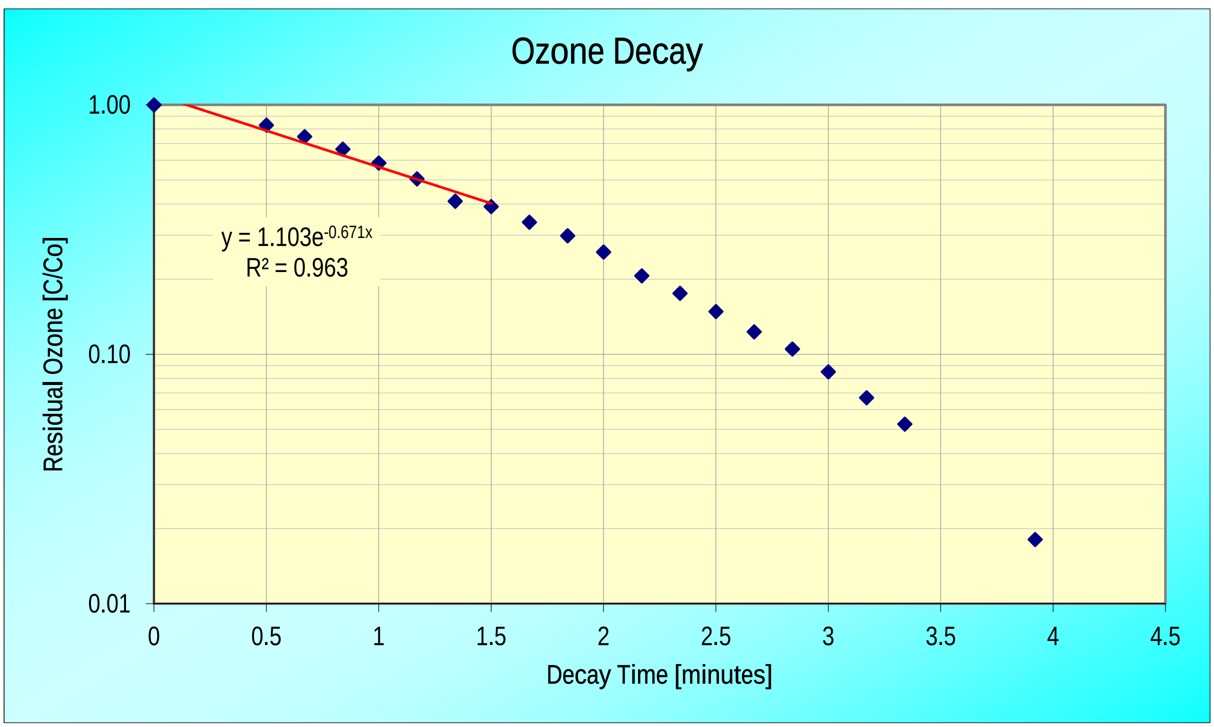
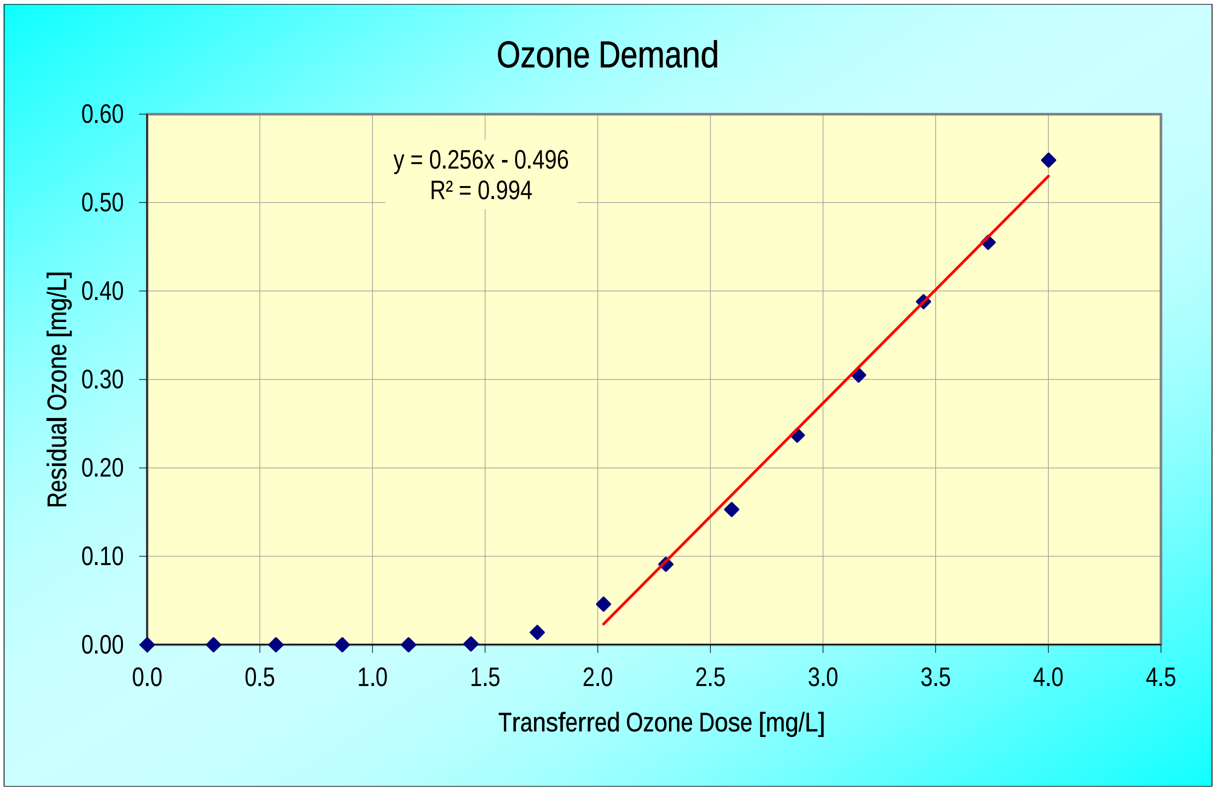


Figure 4-25 – Initial Ozone Residual = 0.5 mg/L, pH = 7.0



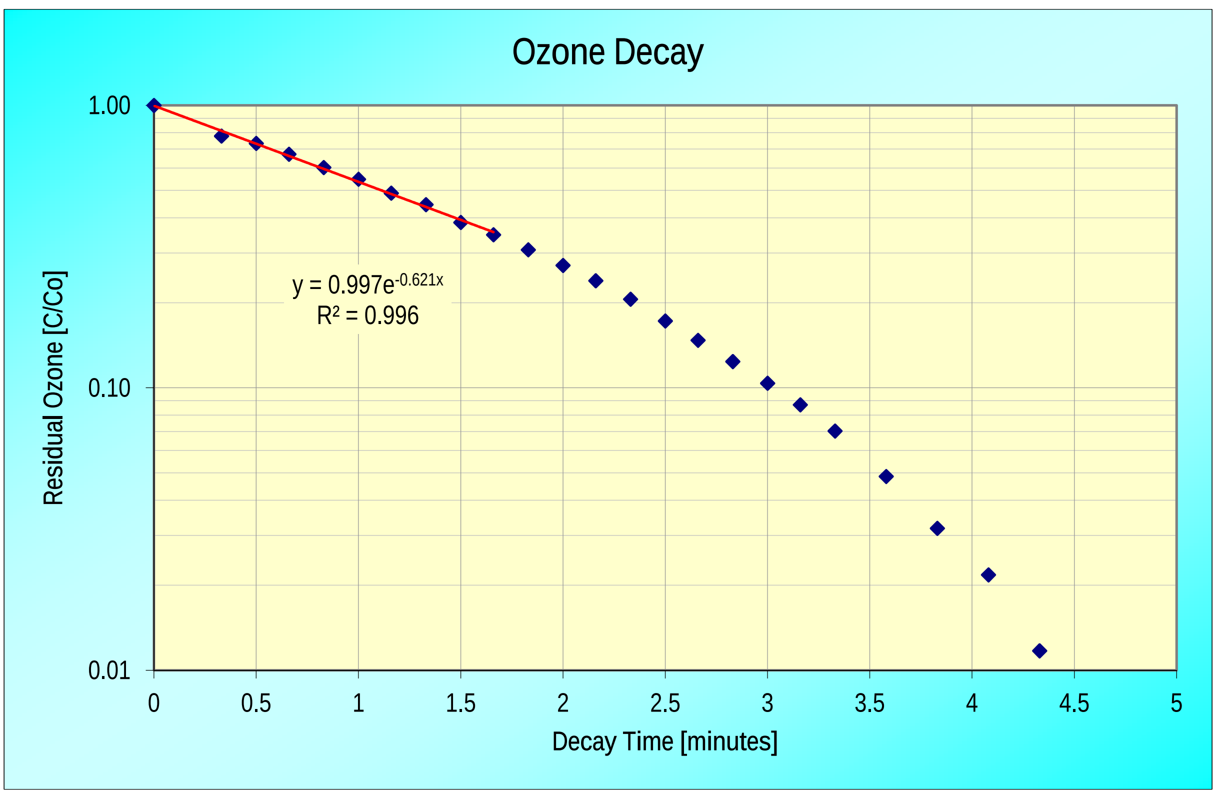
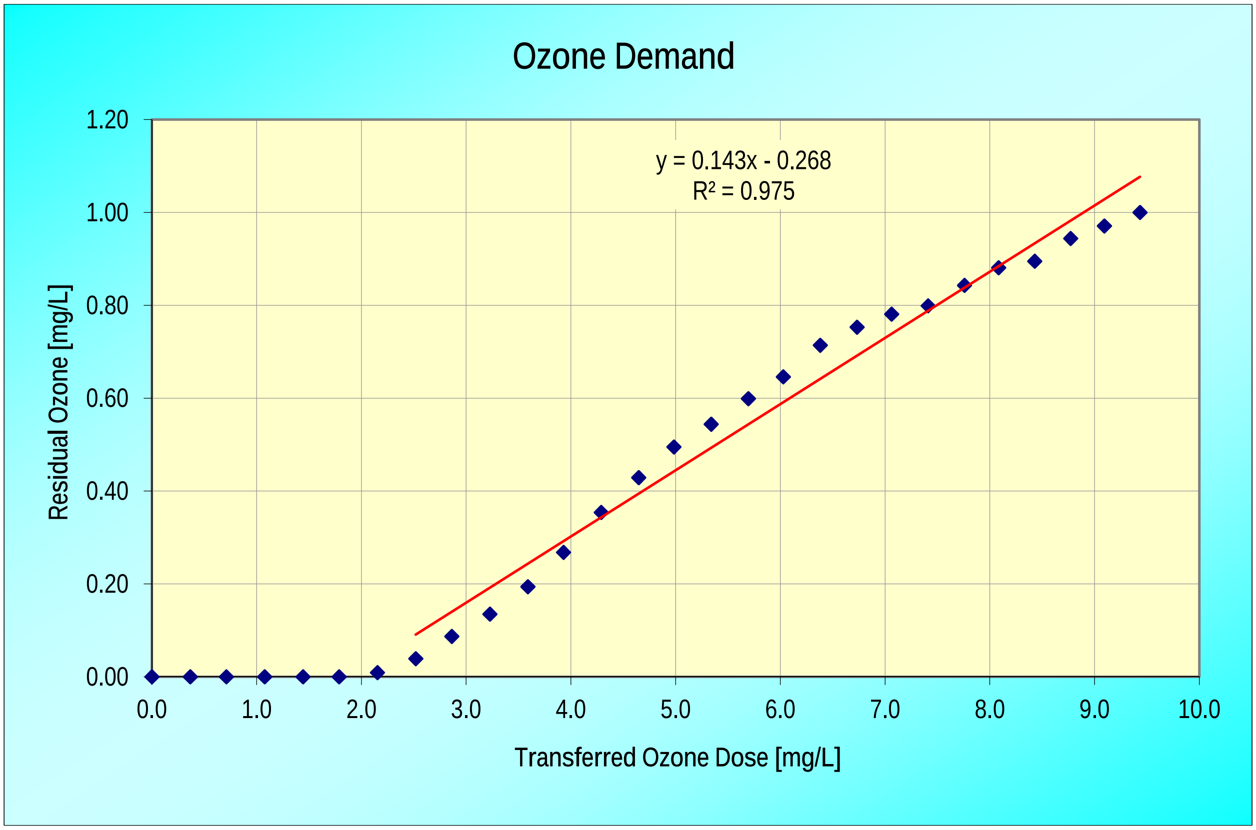


Figure 4-26 – Initial Ozone Residual = 1.0 mg/L, ambient pH



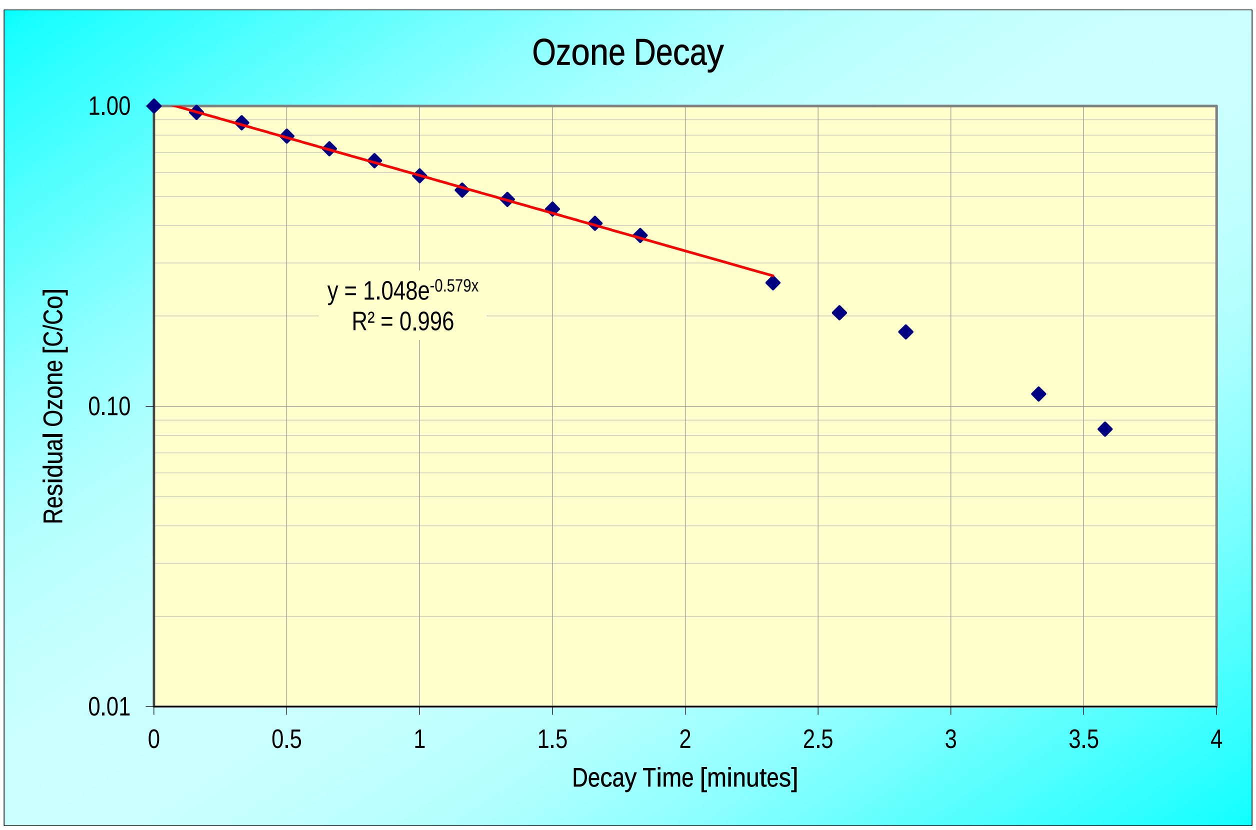
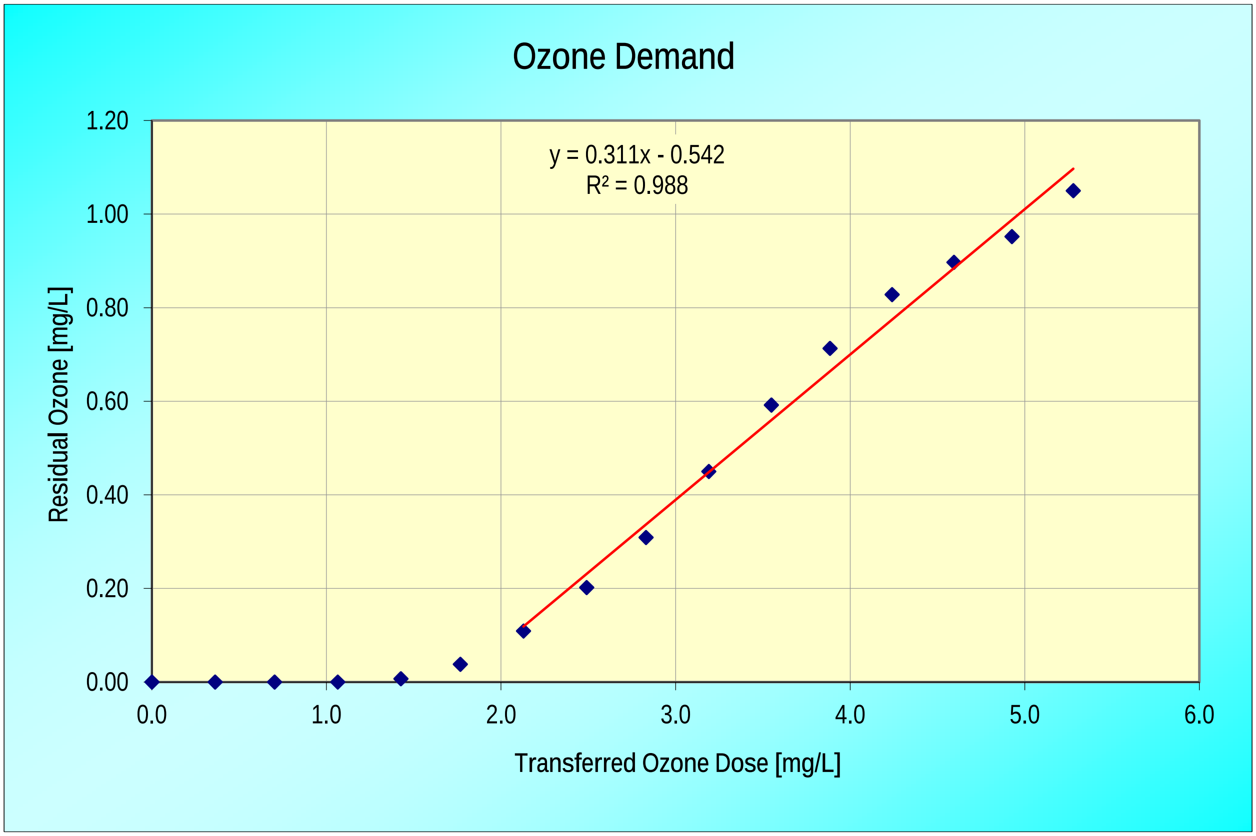
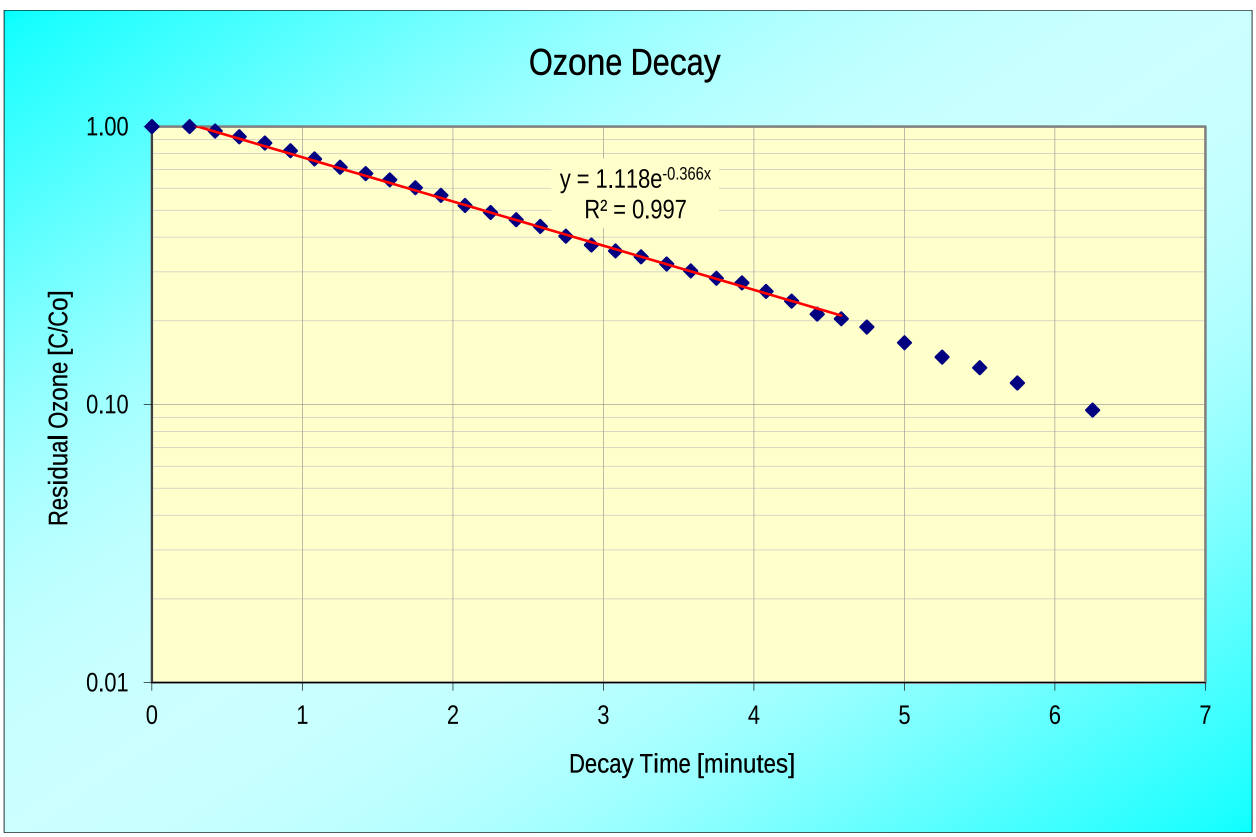


Figure 4-27 – Initial Ozone Residual = 1.0 mg/L, pH = 7.0





4.6 Conclusions from Process Validation Studies

As a result of the bench scale testing the following conclusion was developed:

1. Alum is the preferred coagulant because it performed best in TOC, iron and manganese, and color removal and performed well in turbidity removal. In addition, it is the coagulant currently being used at the Boston Road Treatment Plant so operators are familiar with its use and a steady supply of chemical is available.
2. Significant improvement in coagulation efficiency can be gained by lowering the pH during coagulation. The alum dose required for a 40% removal of TOC fell from over 60 mg/L to about 35 mg/L when the pH during coagulation was lowered to 7.0. Color removal experienced a similar reduction in the required coagulant dose. Turbidity improvements were less pronounced at a pH of 7.0 but more pronounced when the coagulation pH was further lowered to 6.5. It is recommended that sulfuric acid facilities be included in the design of the facility for pH adjustment. The final determination of the pH to use during coagulation will be determined during design based on an evaluation of treatment efficiency and chemical costs.
3. The preliminary design dose for alum is 40 mg/L assuming the coagulation pH is lowered to 7.0 by acid addition. Nearly an equal dose of alum was required to meet the turbidity, TOC, and color removal design goals.
4. Ozone performance is also greatly enhanced at a lower pH. The ozone required to obtain a 0.5 mg/L initial ozone residual falls from 4.5 mg/L at ambient pH to 3.8 mg/L at pH 7. Similarly, a dose of 9 mg/L is required at ambient pH to obtain a 1.0 mg/L initial residual but only 5 mg/L is required at pH 7. Decay rate is also significantly reduced at lower pH levels. Initial residual and decay rate are key design parameters and have significant impact on the construction and operating costs of the ozone system.
5. Bromate formation during ozonation does not appear to be significant on Lake Wright Patman waters. Ozone doses of up to 9.5 mg/L did not lead to bromate formation that exceeded the maximum contaminant level.
6. The Wright Patman water exhibited a very high chlorine demand and high dosages were required to maintain a residual. These high levels can lead to excessive disinfection by-product formation. A more practical solution will be the use of a lower initial residual followed by booster chlorination stations in the transmission systems or at the point of delivery to the wholesale customers.
7. Tests investigating the use of ozone for the oxidation of geosmin are recommended during the next phase of testing to determine the effectiveness and dose of ozone required to remove taste and odor compounds to below detection limits.
8. Further bench scale testing under varying raw water conditions will be required during design to confirm these conclusions. Simulated distribution system tests using chloramines as the secondary disinfectant should be conducted to verify compliance with disinfection by-product requirements.

Section 5
Raw Water Intake, Raw Water Pump Station Site and Raw Water Pipeline

This section of the report describes the process associated with the selection of a site for the raw water intake and raw water pump station.

5.1 Background Issues Relating to Lake Wright Patman Operations

Lake Wright Patman, being a shallow lake, offers some unique challenges to raw water intake operations. Additionally, the current operating rules employed by the U.S. Army Corps of Engineers (USACE) require seasonal variations in the conservation pool of Lake Wright Patman which further complicate the raw water intake operations. In summary, the current operating rules require that the USACE maintain a conservation pool level of 220.6 feet NVGD (National Geodetic Vertical Datum) between the months of November and April. After April 1, the reservoir conservation pool is allowed to rise to a maximum elevation of 227.5 feet NVGD by the beginning of June. After June 1, the conservation pool is slowly reduced to a maximum elevation of 225.0 feet NVGD on October 1. After October 1, the conservation pool continues to drop back to 220.6 feet NVGD.[15]

The contract between the City of Texarkana and the USACE grants the City of Texarkana storage in Lake Wright Patman above elevation 220.0 feet NVGD and the USACE operating procedures maintains the lake at or above 220.0 feet NVGD. However the City of Texarkana's contract allows withdrawal from storage below 220.0 feet NVGD during dry periods with permission from the USACE. The top of the sediment pool is approximately 215.25 feet NVGD. Freese and Nichols assessed the operation of Lake Wright Patman and Jim Chapman in a study titled System Operation Assessment of Lake Wright Patman and Lake Jim Chapman and dated 2003. Using a yield model Freese and Nichols determined in that the contract operations using storage only above 220.0 feet NVGD and the existing rule curve only provides a yield of 8,974 acre-feet per year. Freese and Nichols identified this simulation as Run I-1. In another yield model simulation labeled I-2 Freese and Nichols determined that extending the storage to 217.5 feet provides a yield of 104,397 acre-feet per year, closer to but still short of the current contracted amount of 108,700 acre-feet per year provided by the USCAE contract or the current water rights permitted amount by the Texas Commission on Environmental Quality (TCEQ) of 180,000 acre-feet per year. The I-2 simulation indicates that the reservoir level dropped below 220.0 feet NVGD 15 times during the 64 year simulation period. In a third simulation, I-3, Freese and Nichols found that extending the storage to the sediment pool (215.5 feet NVGD) further increases the yield to 154,205 acre-feet per year. In simulation I-3 model indicated that the reservoir level dropped below 220.0 feet NVGD 27 times during the 64 year simulation period[16]

The Freese & Nichols study indicates that the water levels in Lake Wright Patman can be expected to drop below 220.0 feet NVGD during dry periods; therefore, the new intake should be planned to provide a reliable water supply with a reservoir level of at least 217.5 feet NVGD and offer some contingency

[15] Freese & Nichols; System Operation Assessment of Lake Wright Patman and Jim Chapman; January 2003
[16] Freese & Nichols; 2003

operation down to a reservoir level of 215.0 feet NVGD. Planning for operations at these levels will offer the Member Cities a more reliable water supply even during extreme drought periods

The existing Lake Wright Patman Raw Water Intake is a 5.25 feet high conduit set at a flow line elevation of 210. 0 feet msl and has a top elevation of 215.25 feet msl. With this elevation, the intake is only submerged 2.25 feet when the reservoir level drops to 217.5 feet and by only 0.25 feet when the reservoir drops to 215.5 feet. As the lake level approaches the top of the intake, a phenomenon known as vortexing will occur. This phenomenon is characterized by whirlpools forming above the intake. These whirlpools convey air into the intake pipe thus reducing the capacity of the intake pipeline. The lower lake levels also result in lower levels in the raw water pump station where the same vortexing phenomenon will reduce the capacity of the raw water pumps. It is to be noted that this phenomenon has been experienced at higher water levels as noted by TWU.

5.2 Site Requirements

The most critical site requirement is access to deep water near the shore of Lake Wright Patman and in a location that will facilitate relatively short raw water pipeline lengths to potential water treatment plant sites, including the existing New Boston Road Water Treatment Plant site. The site should also have relatively steep banks to allow cost effective construction of the raw water pump station that is protected from a maximum flood elevation of 259.5 feet NVDG. The site should also be accessible or can become accessible with construction of minimal new infrastructure, and the site should also have access to sufficient electrical power infrastructure to support the new pump station. As a minimum, the site should be able to be served by a reliable 15 KV power line and hopefully redundant 15 KV lines.

5.3 Site Recommendations

Figure 5-01 illustrates the northern portions of Lake Wright Patman along with the bottom contours. The figure also shows the existing intake elevation and a measured bottom elevation of approximately 212 feet msl.[17] A more desirable site is also illustrated on Figure 5-01 that has a bottom elevation of approximately 204 feet msl less than 1000 feet from the lake shore offering the opportunity to draft water from Lake Wright Patman down to the sediment pool (reservoir level of 215.5 feet NVDG) and access the RWRD Member Cities' full water rights.[18]

This site offers several advantages over the existing site the most important being deeper water near to shore. Comparatively the existing intake site is over 3000 feet from a water depth of 206 feet msl. A new pump station and a new raw water intake pipeline that is over 2000 feet longer would be required to offer a system with an equivalent capability to access the RWRD Member Cities' water rights as that provided by the recommended site.

The new site will require construction of approximately five mile of electrical power line and approximately five miles of roadway. The lengths of raw water pipelines for the various water treatment plant sites are presented in Section 6 of this report.

Raw Water Pipeline

[17] MTG Engineers & Surveyors; Survey of Lake Wright Patman Intake location; 2006
[18] Texas Water Development Board Bathymetry Survey; 2010

The raw water pipeline will convey water from the raw water pump station to the water treatment plant. The raw water pipeline should have sufficient capacity to convey the anticipated peak demand for the water treatment plant plus any possible industrial raw water needs. The raw water intake is sized for the ultimate system flow of 60 mgd, but the raw water pipeline can be phased as the water treatment system is expanded. For the purposes of this study, two phases of raw water pipeline construction is assumed, yielding an initial phase with a capacity of 30 mgd.

The initial size of the pipeline was established using a maximum peak velocity of 6 feet per second (fps), yielding a 42-inch diameter pipeline with a maximum velocity of 4.8 fps. The 42-inch diameter was selected over a 36-inch diameter because the 36-inch diameter slightly exceeded the 6 fps guideline. The 42-inch diameter pipeline will allow more future flexibility, lower operating costs for a small increase in initial cost.

The 42-inch diameter pipeline will have a head loss of 2.1 feet per 1000 feet of pipeline at a flow of 30 mgd and a 1 foot per 1000 feet of pipeline at a flow of 20 mgd.

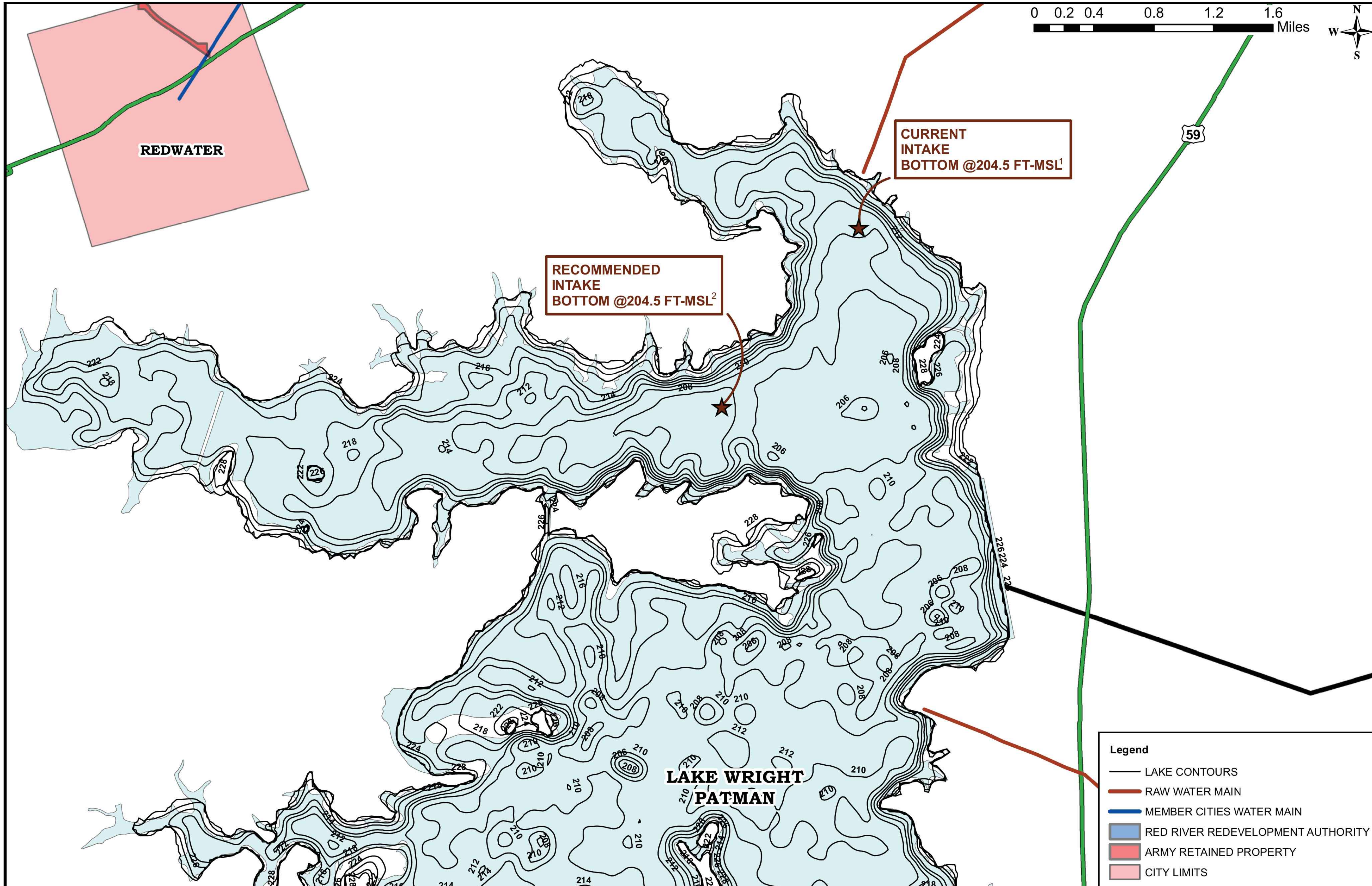


FIGURE 5-01
LAKE WRIGHT PATMAN
RECOMMENDED INTAKE LOCATION

CH2MHILL

10nc502d_420807.dgn

The new site shown on Figure 5-01 is recommended as the new raw water intake and raw water pump station site. This site offers the following advantages over the existing site:

- The depth of the intake is deep enough to assure a water supply from Lake Wright Patman all the way down to the sediment pool elevation of 215.5 feet NVGD.
- The intake and raw water pump station system can be optimally designed to draft the desired ultimate flow of 60 mgd and flows at lower increments from Lake Wright Patman all the way down to the sediment pool elevation of 215.5 feet NVGD.
- The new site is less susceptible to siltation than the existing site as evidenced by the absence of substantial silt in the new location as confirmed by the TCEQ 2011 hydrographic survey data.

5.4 Design Concept Recommendations

The design concept recommended for the new raw water intake and pump station is similar to the existing system, a raw water conduit extending out into the lake to a point where the desired intake elevation is above the bottom elevation and a raw water pump station located on the shoreline using multiple vertical pumps in a wet well configuration. The raw water conduit will require excavation of the lake bottom so that the conduit can be installed at a maximum elevation of 204 feet msl.

Section 6
Water Treatment Plant Site Selection

This section of the report describes the process associated with the selection of a site for the new water treatment plant.

6.1 Site Requirements

The water treatment plant site, be it the existing site on New Boston Road or a new site, should have certain characteristics that allow for the efficient development and operation of a water supply system for the Member Cities of the Riverbend Water Resources District. The following summarizes those criteria:

- Site Suitability – The site should have usable sufficient area to efficiently develop a 60 mgd water treatment plant; therefore, the site should have approximately 50 usable acres (30 acres if off-site disposal of sludge through the sanitary sewer system is an option). The site should be rectangular with a length to width ratio of no more than 3 to 1. The site should be gently sloping with grades of one to five percent. The site should not be encumbered by floodplains drainage ways that convey off site water or any other constraints to efficiently developing the site as a water treatment plant.

- Accessibility – the site should be accessible to the raw water supply source, Lake Wright Patman. Accessibility to raw water supply does not imply that the site should be adjacent to the lake, but it should be in the proximity to a direct line between the raw water source and the existing RWRD Member City Treated Water Transmission Pipeline so that development of the water supply will not require unnecessary lengths of pipeline, either raw water or treated water. The site should also be accessible to major roadways to facilitate delivery of construction materials and water treatment supplies, and to reliable electrical power for energy for the water treatment plant.

- Environmental – The site should not include any environmentally sensitive areas such as critical habitat for threatened or endangered species, wetlands or culturally significant sites.

- Community Concerns – The site should be consistent with existing and planned land uses (noise, lighting and chemical storage), zoning, and should not create a traffic nuisance from construction and/or operations traffic.

Site size was based on the land area required to accommodate the projected maximum future capacity of the plant (60 mgd) with the processes anticipated to treat Lake Wright Patman water. The treatment processes anticipated at the plant are:

- Rapid Mix
- Flocculation/Sedimentation
- Ozone
- Filtration
- Disinfection
- Clearwell Storage and High Service Pumping
- Sludge Storage in Lagoons

Major structures and facilities for the Riverbend WTP include an administration and control building, chemical building, rapid mix, flocculation and sedimentation basins, ozone generation building and contact basins, filter complex, finished water clearwell, high service pump station, and sludge storage lagoons.

Using the design criteria required by the Texas Commission on Environmental Quality (TCEQ) for water treatment plant design, the estimated minimum area required for the treatment facilities is 50 acres. Depending upon the topography of the land, existing easements or floodplains, and the configuration of the facilities, a larger area may be required. A larger site would provide additional area for a buffer zone between the plant and adjacent neighborhoods as well as improve on-site aesthetics and provide room for future treatment processes and provide room for future treatment processes should future regulations or source water quality changes require additional treatment.

6.2 Candidate Site Selection

An Initial identification of candidate sites was made through a review of maps and on-site inspections. The candidate sites were selected based upon the proximity to the raw water source from Lake Wright Patman and the anticipated areas of primary demand for water within the proposed RWRD regional water system. All of the proposed sites lie along the 30" diameter section of the RWRD Member City transmission main which extends from the existing New Boston Road WTP to roughly the eastern boundary of the Red River Army Depot. This corridor allows immediate connection of the new plant to the existing RWRD Member City transmission main.

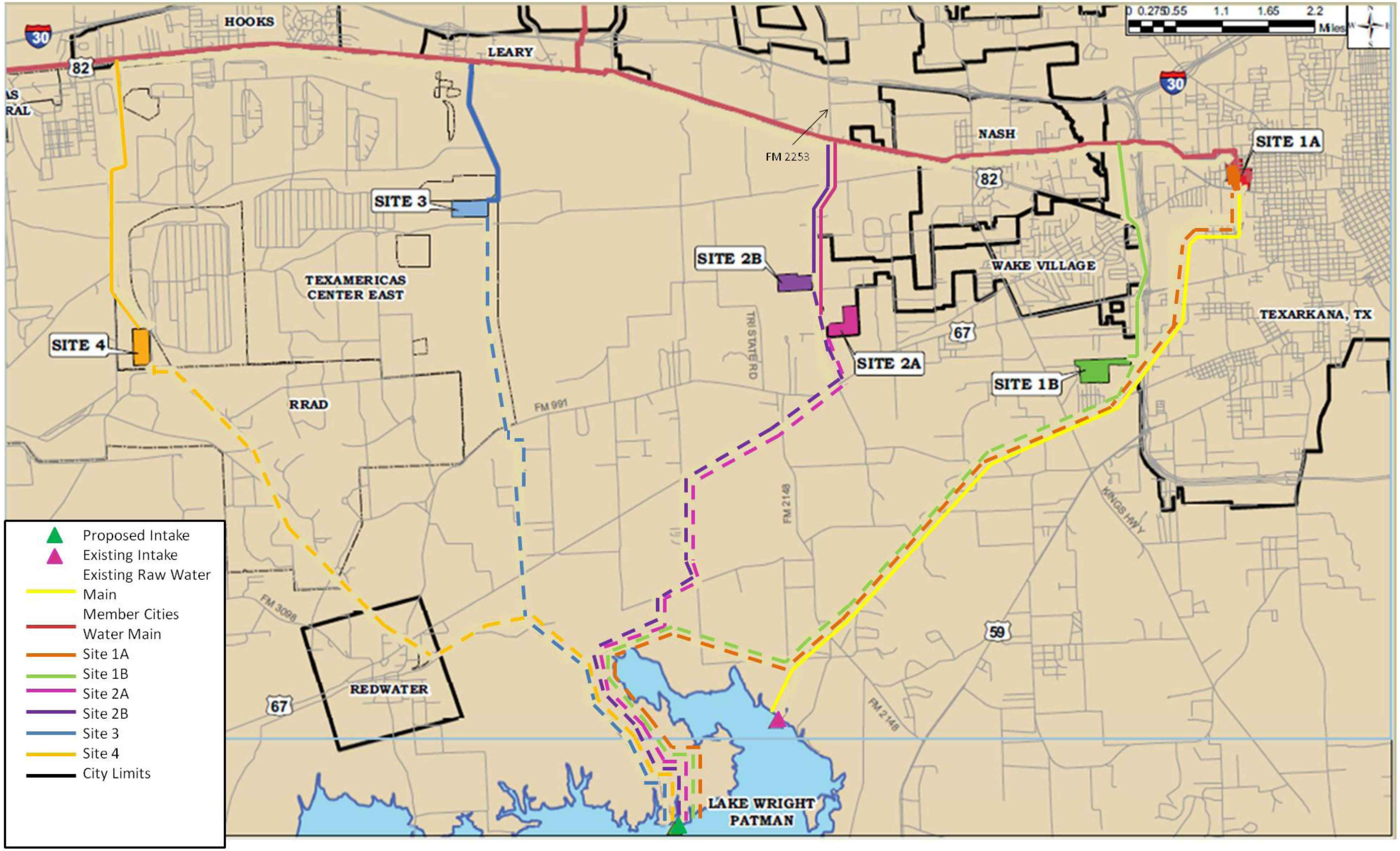
Based on the above criteria, and anticipated land availability four sites were initially selected for evaluation. These were:

- Site 1A –New Boston Road WTP (may require expansion of the site to allow plant expansion)
- Site 2A – Property owned by the City of Wake Village on FM 2148
- Site 3 – Property owned by the TexAmericas Center in the former Lone Star Army Ammunition Plant (formerly Red River Redevelopment Authority) along Bowie County Parkway (former Central Avenue)
- Site 4 – Property owned by the TexAmericas Center in the southwest corner of the former Lone Star Army Ammunition Plant and contiguous to the Red River Army Depot.

Following the initial set of public meetings, two additional sites were added for evaluation based on public input. These were:

- Site 1B – Along the Jarvis Parkway corridor near its intersection with the existing member cities raw water main
- Site 2B – Along the FM 2148 corridor and slightly north and west of Site 2A as an alternative in the event that the Wake Village property is unavailable or improperly configured.

The location of these sites is shown in Figure 6-01. The following section describes the process used to evaluate these sites.



SITE PLAN
1"=100'

FIGURE 6-01
SYSTEM CONFIGURATION
ALTERNATIVES

10nc500d_420807.dgn

CH2MHILL

6.3 Site Evaluation Methodology

The more detailed site evaluation described in this section investigated each potential site based on a number of specific evaluation criteria. These criteria were given weighting factors from A through D, with A being the most important, based on the perceived relevance for site selection. The following paragraphs describe each of these criteria and the way they will be used to evaluate and score potential sites.

Accessibility - Site accessibility to major modes of transportation is important for several reasons. Foremost is the need for good roads with easy access to major thoroughfares to ensure reliable truck delivery of the necessary treatment chemicals. Railroads have also been used for this purpose in the past, but are declining in treatment plant chemical hauling because of the cost, except for very large plants. For this reason, railroad proximity was not a major consideration in this study.

Good accessibility is also an advantage during construction when heavy equipment, materials, and large numbers of workers will be regularly traveling to the site. Should the plant eventually choose a method of solids disposal which requires the hauling of sludge, close proximity to thoroughfares is a major advantage.

Accessibility will also be evaluated based on the ability to access the site without traveling on roads within residential neighborhoods, with limited capacity, that are in poor condition, or are subject to heavy traffic. Most accessibility problems can be solved or at least mitigated through additional construction or operational changes. For site selection purposes, accessibility was given a **B weighting**.

Scores will be based on the following:

5 – Major thoroughfare access (Farm to Market road or better) to the plant site

4 - Major thoroughfare access (Farm to Market road or better) to within 1 mile of the plant site and non-residential paved roads with suitable bridges the remainder to the site

3 - Major thoroughfare access (Farm to Market road or better) to between 1 and 5 miles of the plant site and non-residential paved roads with suitable bridges the remainder to the site.

2. - Major thoroughfare access (Farm to Market road or better) to within 1 mile of the plant site but remaining roads to the plant are not suitable or are through residential neighborhoods

1 - Major thoroughfare access (Farm to Market road or better) to between 1 and 5 miles of the plant site but remaining roads are not suitable or are through residential neighborhoods or no major thoroughfare access within 5 miles of the site.

Community Concerns Public perception plays a role in how well the new plant will be received by the community. Highly visible sites, such as those within a residential area or those located on prime commercial property, may not be as desirable if the public views them as out of place in the neighborhood. In today's society, it is very important for public entities to be good neighbors. Public concerns may include traffic, noise, visual impacts, neighborhood impacts, or safety. While a new treatment plant will impact the community to some degree in all of these areas, it will need to change the nature of the nearby community in order to be considered significant. Public concerns cannot be taken lightly and have thus been given a **B weighting**.

Scores will be based on the following:

5 – No significant community concerns

4 – One significant community concern

3 – Two significant community concerns

2 – Three significant community concerns

1 – Four or more significant community concerns

Construction Costs The cost of construction is one of the most important factors in the selection of a site. Construction costs can be influenced by the following factors:

- Site terrain
- Land costs
- Soil conditions which may require additional foundation design
- Groundwater levels which necessitate dewatering facilities
- Required drainage improvements
- Environmental issues which would need to be addressed
- Costs of pipelines to the plant and accessibility to the treated water distribution system
- Roads and other access to the site which may need to be constructed
- Accessibility of equipment and materials to the site

Because controlling costs is vital to the success of the new District, the potential impact of a site on construction costs was given an **A weighting** in the site selection criteria.

Scores will be based on the following schedule:

5 – Construction cost 15% or more below the median cost

4 – Construction cost between 5 and 15% below the median cost

3 – Construction cost within +/- 5% of the median cost

2 – Construction costs between 5 and 15% above the median cost

1 – Construction costs more than 15% above the median cost

Electrical Power Availability This criterion determines the proximity of electrical power to the site. The length of power lines to serve the site must be evaluated in regards to both the cost and reliability. Water treatment plants and pump stations can consume significant amounts of electricity and power availability can be a major criterion in site selection particularly in rural areas where the power grid is not as highly developed. Also, electrical service is generally a cost factor, since reliability may need to be added to the system through dual electrical feeds or installation of emergency power generators. Because of the impact on costs and the possibility of needing significant improvements to the power grid to supply the new plant, electrical power availability was been given a **B weighting**.

Scores will be based on the following:

5 – Plant located within 10 miles of a suitable substation and has adequate power available within 1 mile of the site and the availability of dual feed

4 - Plant located within 10 miles of a suitable substation and has adequate power available within 1 mile of the site but dual feed not available

3 - Plant located within 20 miles of a suitable substation and has adequate power available within 5 miles of the site and the availability of dual feed

2 - Plant located within 20 miles of a suitable substation and has adequate power available within 5 miles of the site but dual feed not available

1 – Plant not located within 20 miles of a suitable substation or adequate power not available within 5 miles of the plant site

Environmental Impacts Environmental impacts on site selection can range from being negligible to being the issue that removes a site from consideration. Environmental impacts will be evaluated on a preliminary basis by using existing information. The environmental issues that will be considered include the following:

- Is the area in a wetland?
- Are endangered flora or fauna present?
- Is the site of archeological interest?
- Is the area in a floodplain?
- Does the site have environmental damage from previous land uses?
- How will site activity affect the quality of the adjacent environment-i.e., storm water runoff, noise, wildlife habitat loss, visual impact?
- How could potential accidental chemical spills or releases affect nearby air and water quality?

Since these issues can remove a site from consideration, they were given a **B weighting**.

Scores will be based on the following:

5 – No environmental concerns

4 – One environmental concern

3 – Two environmental concerns

2 – Three environmental concerns

1 – Four or more environmental concerns or any concern that cannot be mitigated

Geotechnical Considerations This criterion involves evaluation of the soil conditions at each individual site as well as the location of unusual or unstable geological formations in the area. Geotechnical considerations will be evaluated on a preliminary basis using United States Department of Agriculture soil surveys. The geotechnical concerns considered are shown below:

- Soil shrink-swell potential
- Soil corrosivity
- Foundation suitability of soils
- Depth to perched water tables
- Depth to bedrock
- Type of soil materials

Existing geotechnical reports were used initially to evaluate soil in the area. Although it may be expected that many of the soil features found at a particular site would be similar to other sites in the same geographical area that is not always the case. Soil conditions can vary dramatically within relatively short distances. Therefore, a preliminary geotechnical investigation will be conducted at each of the potential sites during the final evaluation. Geotechnical considerations received a **C weighting**.

Scores will be based on the following:

5 – No geotechnical concerns

4 – One geotechnical concern

3 – Two geotechnical concerns

2 – Three geotechnical concerns

1 – Four or more geotechnical concerns

Operating Economics The primary factor relating site selection to operating cost is the cost of raw and finished water pumping required. Pumping costs are influenced by the topographic elevation and by the distance of the plant from its major customers. Pumping costs include raw water and finished water pumping costs. The elevation of the plant site affects each of these costs. Theoretically, an increased elevation will decrease finished water pumping costs while increasing raw water pumping costs by a similar amount.

The other factor is the distance the water is being pumped. The further the water must be pumped from the lake to the plant or from the plant to the customers the higher the cost. Pipe sizes can be adjusted to help minimize this impact but plant locations near the raw water source or near the center of water demand will have the highest economic benefits regarding operating costs.

This criterion was given an **A weighting**.

Scores were based on the following:

5 – Operating costs 25% or more below the median cost

4 – Operating costs between 10 and 25% below the median cost

3 – Operating costs within +/- 10% of the median cost

2 – Operating costs between 10 and 25% above the median cost

1 – Operating costs more than 25% above the median cost

Permit Requirements/Zoning This criterion was used to evaluate the degree of difficulty in obtaining governmental approvals to use a particular site for building a water treatment plant. The present zoning of a parcel of land will affect the relative ease with which it can be re-zoned for public utility use. For example, it is likely that a parcel zoned for commercial or industrial use could be more easily re-zoned for public utility use than could a parcel zoned residential.

Likewise, the use of land presently owned by a government may require more paperwork and permits to gain approval for utility use than would private property. Since approvals are generally much easier to obtain in rural areas than in more highly developed areas, this criterion was given a **D weighting**.

Scores were based on the following:

5 – No permits or zoning required

4 – Permit or zoning required through one agency but no issues anticipated

3 – Permit or zoning required through multiple agencies but no issues anticipated

2 – Permit or zoning required and issues are possible

1 – Permit or zoning required and multiple issues exist

Topography The topography of a site is important for several reasons. From a treatment plant process perspective, a site with a certain amount of slope can limit or eliminate the need for in-plant pumping and allow the use of smaller diameter lines to transfer water among the treatment processes.

A site with no grade makes drainage more difficult, whereas a site with excessive slopes is subject to erosion and can create construction difficulties. The locations of streams and floodplains running through or near the site are important in computing the actual quantity of land available at a site for construction of water treatment facilities. Topography of the site was given a **C weighting** because, although these factors influence design, they rarely eliminate a site from consideration once a site reaches detailed site evaluation.

Scores were based on the following:

5 – Ideal site conditions

4 - Minimal modifications required for site layout

3 – Moderate site modifications required

2 – Significant site modifications required

1 – Site difficult to make suitable for water treatment plant

Area Requirements - The land area requirement is based on the projected maximum future capacity of the plant (60 mgd) and the processes anticipated to treat Lake Wright Patman water. The treatment processes anticipated at the plant are:

- Rapid Mix
- Flocculation/Sedimentation
- Ozone
- Filtration
- Disinfection
- Clearwell Storage and High Service Pumping
- Sludge Storage in Lagoons

Major structures and facilities for the Riverbend WTP include an administration and control building, chemical building, rapid mix, flocculation and sedimentation basins, ozone generation building and contact basins, filter complex, finished water clearwell, high service pump station, and sludge storage lagoons and provide room for future treatment processes should future regulations or source water quality changes require additional treatment.

Using the design criteria required by the Texas Commission on Environmental Quality (TCEQ) for water treatment plant design, the estimated minimum area required for the treatment facilities is 50 acres. Depending upon the topography of the land, existing easements or floodplains, and the configuration of the facilities, a larger area may be required. A larger site would provide additional area for a buffer zone between the plant and adjacent neighborhoods as well as improve on-site aesthetics and provide room for future treatment processes. Because the area requirement is the single most important site selection criterion, it was given an **A weighting**.

Scores were based on the following:

5 – Site size suitable for current and future conditions

3 – Site size suitable for current conditions but may be marginal for future conditions

1 – Site size marginal for current conditions and unacceptable for future conditions

Existing/Future Easements The amount of land available for a water treatment plant can be significantly affected by easements on the property. If sites are in or near existing or planned utility or railroad easements or are in areas where future roadways are planned, the locations of the facilities on the site may need to be adjusted. The area of land available for the water treatment plant at those sites affected by easements must be adjusted accordingly. The presence of easements is not expected to have a significant impact on the evaluation of the sites under consideration. Easements received a **D weighting**.

Scores were based on the following;

5 – No easements

3 – One easement but can be mitigated with site layout

1 – More than one easement or an easement that would be difficult to mitigate with site layout

Site Ownership This criterion is similar to land costs except that it considers the difficulty of negotiating and purchasing the land. There may be instances, such as those involving sites owned by the Federal government, where long-term leases may be required in lieu of an outright purchase. There may also be cases where landowners are not willing to sell regardless of price. This criterion was given a **D weighting** because of the excellent chance of a successful purchase if a site ranks high enough in the evaluation.

Scores were based on the following:

5 – No anticipated issues with site ownership

3 – Potential site ownership issues

1 – Site ownership is anticipated to be contested

6.4 Site Evaluation

Each site has been evaluated based on each criteria. The scores were tabulated in a matrix format. The scores for each factor were multiplied by the weighting factor (with A=4, B=3, C=2, D=1) to develop a weighted score for each factor. The weighted factors for each site were added together to come up with an overall score for each potential site. The higher the score, the more preferred the site. Conceptual layouts of treatment plant facilities on each of the sites are shown in Figures 6-02 through 6-07. A description of the evaluation and the scores assigned to each site for each criterion are as follows:

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Accessibility

Site 1A – Site access will be from New Boston Road which runs along the south edge of the site of the existing plant. Access to the new section of site will either be from New Boston Road via a new access road or from a residential street west of the existing site. Since major thoroughfare access is located within 1 mile of the site and a new access road less than 1000 feet long can be used to access the thoroughfare, this site was given a 4 rating for accessibility. This rating will drop to a 2 if access through the neighborhood is used.

Site 1B – Site access is via FM 989 which is located 2000 feet from the western side of the site. Thoroughfare access is located within 1 mile of the site, but the remaining roads to the plant will be a combination of residential roads and new construction. This site was given a 2 rating for accessibility.

Site 2A – Site access is via FM 2148 which is located 600 feet from the western side of the site. Thoroughfare access is located within 1 mile of the plant site and a new access road less than 1000 feet long will be used for site access to the thoroughfare. This site was given a 4 rating for accessibility.

Site 2B – Access is from FM 2148 which runs along the eastern side of the site. Since direct access from a suitable road is available to this site, it was given a 5 rating for accessibility.

Site 3 – Site access is from Bowie Parkway which is 515 feet from the eastern edge of the site. Thoroughfare access is located within 1 mile of the site and a new access road less than 1000 feet long will be constructed. This site was given a 4 rating for accessibility.

Site 4 – Site access if from Pine Street which is located 8800 feet from the north edge of the site. Major thoroughfare access is located between 1 and 5 miles of the plant site but existing roads are not suitable for plant traffic. This site was given a 1 rating for accessibility.

Community Concerns

Site 1A – This site is located adjacent to the existing Boston Road WTP. Although it is adjacent to the existing facility, the new plant will encroach on the existing neighborhood and occupy currently vacant land. Anticipated community concerns will be noise, traffic, visual impacts and neighborhood impacts. This site was given a 1 rating for community concerns.

Site 1B – This site is located adjacent to a residential neighborhood. Anticipated community concerns will be noise, traffic, and visual impacts. This site was given a 2 rating for community concerns.

Site 2A – Site is located on a site zoned for use as a business park and adjacent to agricultural and some residential land uses. Anticipated community concerns will be visual impacts. This site was given a 4 rating for community concerns.

Site 2B – Site is located primarily adjacent to undeveloped property although some residential areas are located directly adjacent to the site on the east side. Due to the close proximity of the residences, anticipated concerns will be visual impacts and noise. This site was given a 3 rating for community concerns.

Site 3 – Site is located in the TexAmericas development and is zoned for industrial or commercial use. No community concerns are anticipated. Site was given a 5 rating for community concerns.

Site 4 – Site is located in the TexAmericas development and is zoned for industrial or commercial use. No community concerns are anticipated. Site was given a 5 rating for community concerns.

Construction Costs

Site 1A – This site contains a number of factors that could increase construction costs. Land costs are anticipated to be high because several residences will need to be purchased. Part of the site is located in the floodplain so construction in those areas will require mitigation. Sewer line abandonment and municipal water line relocations may be required. An access road to the site will need to be constructed. The lengths of raw and finished water pipelines required to serve the site are the longest of any of the investigated sites. The site terrain, soil conditions, depth to groundwater, required drainage improvements, environmental issues, and accessibility are of typical construction complexity. The one factor which will lower construction costs is that sludge lagoons will not be required since sewer disposal is available. The lack of lagoons keeps anticipated construction costs only 5 to 15% above the median cost so construction was given a 2 rating.

Site 1B – Most construction costs on this site are anticipated to be below average. Site terrain, soil conditions, depth to groundwater, required drainage improvements, environmental issues, accessibility, and land costs are expected to be at or below average costs. Driving up construction costs for this site are the long length of access road required and the length of pipelines to and from the site are the second longest among the site alternatives. There is also a small amount of floodplain mitigation that could be required. Overall, construction on this site is expected to be within plus or minus 5% of the median cost giving it a 3 rating.

Site 2A – Factors negatively impacting construction costs on this site include a short length of access road required and some minor wetlands mitigation. Other factors such as the length of pipelines to and from the site, land costs, required drainage improvements, depth to groundwater, and soil conditions are expected to be about average. Construction on this site is expected to be within 5% of the average cost so it was given a 3 rating.

Site 2B – The primary factor impacting alternative 2B is the drainage swale running down the middle of the site that will need to be rerouted. There will also be considerable amount of earthwork required to construct the appropriate volume of lagoons. Both of these result in moderate levels of increased cost. Some wetlands mitigation may be required. Access is excellent. Soil conditions, depth to groundwater, length of raw and finished water pipelines, and land costs are expected to be at or below average. This site was given a 4 rating because overall construction costs are anticipated to be between 5 and 15 % below the average cost.

Site 3 – This site has the shortest distance of raw and finished water pipelines among the alternatives. Accessibility is good with only a short access road required. Land costs are anticipated to be low and few environmental or drainage impacts are expected. Soil conditions and depth to groundwater are typical. There could be some additional costs for soil relocation associated with the lagoons and the sites topography. Overall construction costs are anticipated to be about 15% below median costs giving the site a 5 rating.

Site 4 – Construction costs for Site 4 are significantly impacted by a large ravine which transverses the site and the long length of access road which will need to be constructed. The cost of pipelines to and from the site are above average. Land costs, environmental mitigation, soil conditions, and groundwater levels are expected to be at or below average. Lagoon construction will require significant earth movement. Overall costs are anticipated to be more than 15% above the median cost giving the site a 1 rating.

Electrical Power Availability

Site 1A – Power is available to the plant site but no dual feed is available. Site was given a 4 rating for power availability.

Site 1B – Power is available to the plant site but no dual feed is available. Site was given a 4 rating for power availability.

Site 2A – Power is available to the plant site but no dual feed is available. Site was given a 4 rating for power availability.

Site 2B – Power is available with ½ mile of the plant site but no dual feed is available. Site was given a 4 rating for power availability.

Site 3 – Power is available near the plant site but no dual feed is available. Site was given a 4 rating for power availability.

Site 4 – Power is available near the plant site but no dual feed is available. Site was given a 4 rating for power availability.

Environmental Impacts

Site 1A – Site has significant floodplain issues. Site activity could directly impact the nearby creek through chemical spills and the adjacent environment could be impacted by noise, wildlife habitat and visual impact. No wetland, endangered flora or fauna, archeological sites, or past environmental damage are anticipated. Site was given a 2 rating for environmental impacts.

Site 1B – Site has floodplain issues. No other significant environmental impacts are anticipated with this site. Site was given a 4 rating.

Site 2A – Site has an area of wetlands that will need to be mitigated or avoided. Environment could also be impacted from habitat loss. No other significant environmental impacts are anticipated with this site. Site was given a 3 rating.

Site 2B – Some habitat loss could occur through removal of wooded areas. An area of wetlands may need to be mitigated. No other environmental impacts are expected. Site was given a 3 rating.

Site 3 – Site is on the Army Depot so environmental issues associated with previous land uses are possible but not anticipated with this site. No other environmental impacts are expected. Site was given a 5 rating.

Site 4 – Site is on the Army Depot so environmental issues associated with previous land uses are possible but not anticipated with this site. Habitat loss associated with this site could be significant. No other environmental impacts are expected. Site was given a 4 rating.

Geotechnical Considerations

Site 1A – No geotechnical concerns were noted with this site. Site was given a 5 rating.

Site 1B – No geotechnical concerns were noted with this site. Site was given a 5 rating.

Site 2A – No geotechnical concerns were noted with this site. Site was given a 5 rating.

Site 2B – No geotechnical concerns were noted with this site. Site was given a 5 rating.

Site 3 – No geotechnical concerns were noted with this site. Site was given a 5 rating.

Site 4 – No geotechnical concerns were noted with this site. Site was given a 5 rating.

Operating Economics

Site 1A – The operating economics for this site based on length of raw and finished water piping is expected to be greater than 25% above the mean of the sites. Site was given a 1 rating.

Site 1B – The operating economics for this site based on length of raw and finished water piping is expected to be between 10% and 25% greater than the mean of the sites. Site was given a 2 rating.

Site 2A – The operating economics for this site based on length of raw and finished water piping is expected to be between 10% and 25% less than the mean of the sites. Site was given a 4 rating.

Site 2B – The operating economics for this site based on length of raw and finished water piping is expected to be between 10% and 25% less than the mean of the sites. Site was given a 4 rating.

Site 3 – The operating economics for this site based on length of raw and finished water piping is expected to be greater than 25% below the mean of the sites. Site was given a 5 rating.

Site 4 – The operating economics for this site based on length of raw and finished water piping is expected to be between 10% and 25% greater than the mean of the sites. Site was given a 2 rating.

Permit Requirements/Zoning

Site 1A – This property is currently zoned residential and commercial and will require a zoning change through the City of Texarkana, TX. Property ownership is a combination of public and private. Flood plain mitigation will require a permit. Permitting was given a 3 rating.

Site 1B – Site is outside city limits and is not zoned. Floodplain mitigation will require a permit. Property ownership is private. Permitting was given a rating of 4.

Site 2A – Current zoning is for a business park and may require a zoning change through the City of Wake Village. Property ownership is public. Permit for wetlands mitigation could be required. Permitting was given a rating of 4.

Site 2B – Property is not zoned and is outside city limits. Property ownership is private. No permits are anticipated and permitting was given a 5 rating.

Site 3 – Site is zoned industrial/commercial so no zoning change is required. Property ownership is public. Permitting was given a 4 rating.

Site 4 – Site is zoned industrial/commercial so no zoning change is required. Property ownership is public. Permitting was given a 4 rating.

Topography

Site 1A – Site has good topography. Floodplain mitigation will require some modification. Topography was given a 4 rating.

Site 1B – Site has good topography. Floodplain mitigation will require some modification. Topography was given a 4 rating.

Site 2A – Site has limited slope which will make locating facilities more difficult to allow gravity flow. Topography was given a 3 rating.

Site 2B – Site had varied terrain and a drainage channel running through the middle of the site. Significant earthwork will be required to promote drainage and locate facilities. Topography was given a 2 rating.

Site 3 – Significant earth movement will be required for lagoon construction. Topography was given a 3 rating.

Site 4 – Site topography is good except for a large ravine in the middle of the site that will need to be mitigated. Topography was given a 3 rating.

Area Requirements

Site 1A – Site is of suitable size provided adjacent residential property is included. Area requirements were given a 5 rating.

Site 1B – Site is of suitable size for current and future requirements. Area requirements were given a 5 rating.

Site 2A – Site is of suitable size for current and future requirements. Area requirements were given a 5 rating.

Site 2B – Site is of suitable size for current and future requirements. Area requirements were given a 5 rating.

Site 3 – Site is of suitable size for current and future requirements. Area requirements were given a 5 rating.

Site 4 – Site is of suitable size for current and future requirements. Area requirements were given a 5 rating.

Existing/Future Easements

Site 1A – No easements were noted. Site was given a 5 rating.

Site 1B – No easements were noted. Site was given a 5 rating.

Site 2A – A utility easement crosses the center of the site but can be mitigated through site layout. Site was given a 3 rating.

Site 2B – No easements were noted. Site was given a 5 rating.

Site 3 – No easements were noted. Site was given a 5 rating.

Site 4 – No easements were noted. Site was given a 5 rating.

Site Ownership

Site 1A – This parcel includes at least 28 land owners including residential owners. Significant difficulty in obtaining all of the required land is anticipated. Site owner ship was given a 1 rating.

Site 1B – No issues with site ownership are anticipated. Site ownership was given a 5 rating.

Site 2A – No issues with site ownership are anticipated. Site ownership was given a 5 rating.

Site 2B – No issues with site ownership are anticipated. Site ownership was given a 5 rating.

Site 3 – No issues with site ownership are anticipated. Site ownership was given a 5 rating.

***Site 4* –** No issues with site ownership are anticipated. Site ownership was given a 5 rating.

6.5 Site Recommendations

The results of the site evaluation are shown in Figure 6-08. The site recommended for the new water treatment plant is Site 3. This site scored well in nearly every evaluation category. The next highest ranking sites are sites 2B and 2A. Site selection was heavily impacted by construction and operation costs associated with raw and finished water pipeline lengths as well as neighborhood considerations associated with site location and the need for mitigation of wetlands or floodplain.

FIGURE 6-08 – SCORING MATRIX
RIVERBEND WTP SITE SELECTION

		Raw Score						Weighted Score					
Evaluation Criteria	**Weight Factor**	**Site No. 1A**	**Site No. 1B**	**Site No. 2A**	**Site No. 2B**	**Site No. 3**	**Site No. 4**	**Site No. 1A**	**Site No. 1B**	**Site No. 2A**	**Site No. 2B**	**Site No. 3**	**Site No. 4**
Accessibility	3	4	2	4	5	4	1	12	6	12	15	12	3
Community Concerns	3	1	2	4	3	5	5	3	6	12	9	15	15
Construction Costs	4	2	3	3	4	5	1	8	12	12	16	20	4
Electrical Power Availability	3	4	4	4	4	4	4	12	12	12	12	12	12
Environmental Impacts	3	2	4	3	3	5	4	6	12	9	9	15	12
Geotechnical Considerations	2	5	5	5	5	5	5	10	10	10	10	10	10
Operating Economics	4	1	2	4	4	5	2	4	8	16	16	20	8
Permitting Requirements	1	3	4	4	5	4	4	3	4	4	5	4	4
Topography	2	4	4	3	2	3	3	8	8	6	4	6	6
Area Requirements	4	5	5	5	5	5	5	20	20	20	20	20	20
Easements	1	5	5	3	5	5	5	5	5	3	5	5	5
Site Ownership	1	1	5	5	5	5	5	1	5	5	5	5	5
Weighted Totals								**92**	**108**	**121**	**126**	**144**	**104**

Weight Factor A=4, B=3, C=2, D=1

Section 7
Connection to the RWRD Member City Water Transmission System

7.1 System Operational Requirements

The Riverbend Water Supply System should be planned to provide a safe and reliable water supply to each of the District's members and their customers at an affordable cost. The critical parameters that must be met include system pressure throughout the system and water quality at each delivery point. Meeting these parameters at an affordable cost requires that the system be planned so that it can operate efficiently through the reasonably anticipated operating scenarios.

System Pressure Maintenance – The existing water transmission system has provided reliable system pressures to the Member Cities for several decades. The existing water transmission system operates at the Texarkana Water Utilities (TWU) retail system pressure gradient which is more than adequate to deliver water to Annona, the most remote RWRD Member City. The TWU is a jointly operated water department of the Cities of Texarkana, Texas and Texarkana, Arkansas. The system could be more efficiently operated if the bulk of the system (west of FM 2253) were disconnected from the TWU system and allowed to operate at a minimum pressure of 25 PSI or the pressure required to service each delivery point whichever is less. This is the most efficient location to separate the TWU system from the RWRD Member City System and a location that minimizes impacts to the two systems and gains the maximum benefits. This location does leave some overlap between the two systems in that water delivered to Nash and Wake Village will still be conveyed through a part of the TWU system. This approach is possible because the RWRD Member City System is not a primary fire protection system. The fire protection outside of the TWU system is provided by the member cities own water distribution systems. The benefit of this new configuration is the members will only have to pay for the energy to deliver the water at the specific pressures required to meet system requirements. Under this configuration, the TWU system will still operate at its current system pressure. The full implementation of this approach is subject to further analysis and assessment during the design development phase.

The benefit of this new configuration is the members will only have to pay for the energy to deliver the water at the specific pressures required to meet system requirements. Under this configuration, the TWU system will still operate at its current system pressure.

Water Quality Maintenance – The first key to water quality maintenance is to produce stable water at the water treatment plant. The proposed water treatment process discussed in Section 4 will meet that objective; however, it is recommended that member cities maintain the capability to rechlorinate at their delivery points should an unexpected drop in chlorine residual occur.

The second key is to protect the water supply in the transmission system. Currently, each delivery point to a RWRD Member City is through a top entry ground storage tank that offers a positive air gap between the discharge pipe and tank water surface. This configuration protects the water transmission system from possible backflows of water from a RWRD Member City system that could inadvertently contaminate the system. This configuration should be continued and perhaps even expanded to isolate the TWU system from the remainder of the system.

7.2 Recommended System Configuration

Figure 7-01 illustrates a schematic of the recommended connection to the RWRD Member City Water Transmission System. This configuration isolates the TWU system from the system that delivers water to all members west of FM 2253. Nash and Wake Village will continue to be served from the TWU system. Water flow through their meters will need to be subtracted from the TWU delivery meter to determine the quantity of water delivered to TWU. By isolating the TWU system, the pressure in the remainder of the RWRD Member City System can be reduced to a level that meets the specific requirements to deliver water to each member and maintain a minimum system pressure of 25 psi. The system will still have a valved connection to allow emergency operations if needed. This configuration also isolates every RWRD Member City, including TWU, from the RWRD Member City System thus protecting the water quality in the system.

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Contact publicinfo@twdb.state.tx.us to request this page

Section 8
Implementation

8.1 Permit and Right-of-Way Issues

Development of the new water supply system for the RWRD will require some permits to be secured. The City of Texarkana holds water rights permit number CA 4836 which grants the City 45,000 acre-feet per year from Lake Wright Patman for municipal use and another 135,000 acre-feet per year for industrial uses. That quantity of raw water for municipal uses is more than enough to support a 60 mgd water treatment plant assuming a 2 to 1 peaking factor; therefore, the quantity of water available is sufficient for the District's needs in the foreseeable future. If the raw water intake location is changed, a minor permit amendment will be required to designate the new intake point. Such an amendment is typically an administrative procedure.

Construction of the raw water intake will require a Section 404 permit from the US Army Corps of Engineers (USACE), but the scope of the project will most likely fall under a Regional General Permit. Additionally Lake Wright Patman is owned and operated by the USACE and the raw water pump station will potentially be located on USACE property. The Operations Division of the USACE will require review and approval for any construction in the lake and will require an agreement to construct facilities on USACE property.

The recommended water treatment plant site is located within the Tex Americas Center. The adjacent land uses and zoning are both industrial/commercial. The proposed water treatment plant is consistent with the adjacent land use and zoning so no zoning changes will be required. The land for the water treatment plant will have to be acquired from the Tex Americas Center.

Much of the recommended raw water and treated water pipeline routes are along existing public right-of-way, but there are short segments where right-of-way will need to be purchased.

Both the water treatment plant and the raw water pump station will require significant amounts of reliable electrical power. To assure reliability, both facilities should have either redundant power feeds at or a robust single power feed with local back-up power generation on site.

8.2 Schedule

The development of the new water supply for the RWRD is anticipated to take approximately 39 months as outlined below:

- Preliminary Design,– 6 months
- Final design – 6 months
- Right-of-way acquisition, and permit approvals – 12 Months (concurrent with preliminary & final design)
- Construction – 24 months
- Start-up and commissioning – 3 months

8.3 Cost Projections

Major costs for this project consist of land/right of way acquisition, intake facilities, raw water transmission lines, water treatment facilities, finished water transmission lines, and professional services including engineering, land acquisition assistance, surveying, geotechnical, and ecological evaluations. A brief summary of expected costs in each of these areas is described below.

<u>Land Acquisition/Right-of-Way</u> – Land costs will vary based on the site selected as described in the Section 6 – Water Treatment Plant Site. Typical land costs for the Texarkana area are $10,000 per acre. Except for Site 1, the land costs for each of the prospective WTP sites are anticipated to be at or below the average cost. Due to the high number of residences requiring purchasing for Site 1, land costs are anticipated to be significantly more than the average cost. The anticipated average cost for a 50-acre plant site will be $500,000.

Pipeline right-of-way costs can also vary considerably from near zero for existing right-of-ways to $60,000 per 1000 linear feet for right-of-ways through developed areas. Using a typical mixture of existing, rural, and developed areas where the pipelines will be installed indicates that right-of-way costs for this project will average about $15,000 per 1000 linear feet of pipeline. Total cost for right-of-way acquisition will vary based on the expected length of the required pipeline which is dependent on the intake and WTP sites selected.

<u>Construction Costs Basis</u> – Construction costs were developed using CH2M HILL's construction cost database and CH2M HILL's proprietary CH2M HILL Parametric Cost Estimating System (CPES). The purpose of CPES is to generate quick, relatively accurate, and detailed cost estimates at the conceptual stage of a project, before little or any design work has taken place. The system contains many "mini-models" or cost estimates of facilities that are based on real projects. These mini-models have relationships (or algorithms) built into them that allow the system to adjust their costs based on project-specific information supplied by the user. This system takes actual cost data from the construction of water treatment facilities across the country and develops standard layouts and associated costs for each of the unit processes under consideration. This tool is useful in developing conceptual layouts and budget level costs and for comparing various treatment alternatives. In Phase 2 of this project, CPES was used to evaluate the anticipated costs of treatment alternatives and was used to help select the process with the lowest cost-benefit ratio. Contingencies are included in the construction costs.

<u>Intake Facilities</u> – The costs for the intake facilities include the construction costs for the raw water intake and the raw water pump station. The intake pipeline and the raw water pump station structure will be designed and constructed to accommodate the ultimate capacity of the system (60 mgd), but the equipment installed in the pump station will only be designed to match the water treatment plant capacity.

<u>Raw Water Transmission Lines</u> –The costs for the raw water pipeline include construction costs for a raw water pipeline. The costs assume the initial capacity of the pipeline will be one-half the ultimate water treatment plant capacity (30 mgd). A second parallel pipeline will have to be constructed when the Water Treatment plant is expanded beyond 30 mgd. The costs also assume that water treatment plant site 3 is the selected plant site

<u>Water Treatment Facilities</u> - The costs for the water treatment plant include the costs for the unit processes discussed in Section 4 of this report including sludge lagoons. Costs for plant capacities of 20

mgd, 25 mgd and 35 mgd are presented for information purposes. A plant capacity of 20 mgd will be required to replace the capacity of the existing New Boston Road WTP.

Finished Water Transmission Lines – The costs for the finished water pipelines include the costs of the pipeline that connects the water treatment plant to the RWRD Member City System. The pipeline construction costs are based on a capacity that is 1.25 times the water treatment plant capacity to allow for some diurnal peaking.

Professional Services – Professional services include engineering and other professional services to complete planning permitting and design of the new water supply facilities.

Summary of Anticipated Costs – A summary of estimated costs for each factor is shown below in Table 8-01. These should be considered budget level costs with a level of accuracy of +/- 30%. Costs are assuming that the highest ranking site in the site selection process (Site 3) is used.

Table 8-01 Projected System Implementation Costs

	20 mgd	**25 mgd**	**35 mgd**
Land Acquisition/ROW	$500,000	$500,000	$500,000
Intake Facilities	$13,800,000	$14,000,000	$14,500,000
Raw Water Pipelines	$20,710,000	$20,710,000	$20,710,000
Treatment Plant	$52,350,000	$57,900,000	$69,560,000
Treated Water Pipelines	$6,400,000	$6,400,000	$6,400,000
Professional Services	$9,280,000	$9,890,000	$11,080,000
Total	**$103,040,000**	**$109,400,000**	**$122,750,000**

Treatment plant costs could be reduced by deferring the construction of the ozone facilities until a later date. It is anticipated that this deferral would reduce the initial capital cost by about $12M. This deferral would have a significant impact on finished water quality, however. Taste and odor removal would go from excellent to poor, TOC removal would go from excellent to moderate, and pathogen removal would go from good to moderate. Current water quality regulations will still be met but there will be less ability to meet potential future regulations without the ozone.

The projected project costs are significantly higher than HDR Engineering's projected cost to replace the filter units at the New Boston Road WTP because the two projections are for projects that are not equal in scope or value to the Member Cities. The Scope of the HDR project is to install membrane filters at the New Boston Road WTP to replace the existing granular media filters, repair the existing flocculation sedimentation basins, and add powdered activated carbon facilities at the raw water pump station. The limitations of the HDR Engineering scope is due to the limited focus of the HDR Engineering study as directed by Texarkana Water Utilities. These improvements address only the most urgent needs for the water supply system. The following table (Table 8-02) compares the scope and benefits of the two projects:

Table 8-02 Comparison of Scope and Benefit of Water Supply System Improvements

Scope Item	HDR Project	CH2M HILL Project	Benefit
Replace raw water Intake & pump station	Not Addressed	New raw water intake and pump station in deeper water	Allows for Member Cities to access full water rights in Lake Right Patman. Replaces 50 year old pump station equipment. Both resulting in a more reliable water supply
Replaces raw water pipeline.	Recommends cleaning, inspection of air releases valves and operating at higher pressures to restore capacity.	New raw water pipeline with capacity to one-half the ultimate WTP capacity. Provides right-of-way to add a second pipeline in the future when the system requires expansion	Addresses the unknown structural condition of the existing raw water pipeline, provides more reliability and capacity for expansion of the water supply system. Also provides some excess capacity for industrial raw water sales in the interim thus increasing system revenue.
Replace New Boston Road WTP	Recommends new membrane filters, repairs to existing flocculation/sedimentation basins and chemical feed equipment.	Recommends a new water treatment plant on a new site with room to expand the plant to 60 mgd.	The new water treatment plant will have a modern treatment process that can efficiently address the past water quality concerns from the New Boston Road WTP and meet current and projected water quality rules. The new plant site allows for expansion to promote growth in Northeast Texas.
RWRD Member City Water Transmission Pipeline	Recommends replacement of high service pumps	Recommends new pumping facilities along with a reconfiguration of the RWRD Member City Transmission Pipeline	Provides an expandable pump station to meet growth in the system. Isolates the RWRD Member City System from the Texarkana Water Utilities water distribution system offering more energy efficient operation and better metering of water use by the members.

Project Funding Options

There are a number of possible funding options for proposed improvements. Historically utilities have sold revenue bonds that are supported by revenues from future rates. The estimated annual debt service assuming a 30 year finance period and a four percent interest rate is $6,000,000. Additionally there are a number of funding vehicles available from the Texas Water Development Board that could reduce the annual costs of financing the system. These vehicles include:

- Drinking Water State Revolving Fund – a loan program that allows communities to take advantage of the State credit rating.
- State Participation Program – a program where the State finances a project. The payments for future capacity are deferred and owned by the State until the capacity is needed by future growth.
- Water Infrastructure Fund – Subsidized and deferred funding for water supply projects

Next Steps

This report provides the RWRD with basic information necessary to decide whether or not to proceed with developing a new water supply system to replace the aging Member City System. To proceed, the RWRD needs to establish a basis to finance the project. That basis will require contracts with the member cities to purchase water at a fixed rate basis. With water supply contracts in hand, RWRD can then secure funding to begin development of the project.

Appendix A
Peer Review Letter from HDR Engineering Inc.
March 21, 2012

March 21, 2012

F. Larry Sullivan, Ed. D.
City Manager
City of Texarkana
West 3rd and Texas Blvd.
Texarkana, TX 75501

Re: Peer Review of Riverbend Water Resources District Phase 3 Report on Water Treatment Plant and Raw Water Intake Site Selection

Dr. Sullivan:

HDR Engineering, Inc. (HDR) was requested by the City of Texarkana, Texas (City), to review the draft "Phase 3 Report on Water Treatment Plant and Raw Water Intake Site Selection" (Report), dated January 11, 2012, prepared by CH2M Hill and MTG Engineers and Surveyors for the Riverbend Water Resources District (District). The Report identifies the improvements needed to serve the members of the District with potable water from Lake Wright Patman.

For the Peer Review, HDR conducted the following tasks:

- Reviewed the various water treatment plant (WTP) and raw water intake site alternatives considered.
- Determined potential impacts to the City, including additional facilities not considered as part of the District's proposed improvements for the City to take and use potable water.
- Determined advantages and disadvantages to the City for each of the proposed water treatment alternatives.
- Determined advantages and disadvantages to the City for each of the sites evaluated for the new water treatment facility.

Highlights of the Report

Based on HDR's review, the highlights of the Phase 3 Report are as follows:

- The treatment process was selected to produce potable water meeting State and Federal regulatory requirements as well as local aesthetic restrictions that includes zero taste and odor complaints.

- Potential locations for the new raw water intake in Wright Patman Lake were evaluated and a proposed location was recommended.

- Potential locations for the new water treatment plant in the area surrounding Wright Patman Lake were evaluated and a proposed location was recommended.

- Potential raw water transmission main routings between the proposed raw water intake and water treatment sites were evaluated and a proposed routing was recommended.

- Potential treated water transmission main routings from the proposed water treatment site to the District's member cities were evaluated and a proposed routing/system was recommended.

Potential Impacts to the City

From HDR's review, potential impacts of the proposed Project to the City are as follows:

- The finished water quality will be very different from that currently produced by the New Boston Road WTP. In particular, the oxygen reduction potential (ORP) will be higher from the proposed WTP because of the ozone disinfection process proposed for the new plant. The existing WTP does not use any process that imparts a significant amount of oxygen into the finished water. This change may have an unintended interaction with the existing scale in the City's distribution system (and for that matter all of the District's member cities' distribution systems). This could lead to the release of the existing scale which may cause colored water at the consumer's tap.

- Looking at the costs presented in the Phase 3 Report, it was difficult for HDR to comment on any of the costs, either capital or operation and maintenance. Therefore, HDR requested additional information from CH2M Hill, and the Technical Memorandum on Evaluation of Treatment Alternatives, dated December 1, 2009 (hereafter referred to as TM), was shared with HDR. Based on our review of the additional information, the capital and operation and maintenance costs for all of the alternatives were generated by CH2M Hill's Parametric Cost Estimating System (CPES), and only the assumptions that were used for the model are provided. Therefore, HDR cannot comment on how the costs were developed, but we offer the following comments on the assumptions and how those assumptions may affect the capital and operational costs provided.

    - Rapid Mix. Per Texas Commission on Environmental Quality (TCEQ) "Rules and Regulations," there must be at least two rapid mix basins. In addition, the velocity gradient given is more than twice the generally accepted maximum value.

    - Flocculation. The detention time is more than twice that required by TCEQ (i.e., 20 minutes). So, the capital cost for flocculation may be high.

- Actiflo. The report does not indicate what the assumed sand replenishment, coagulant and polymer rates are, which generally are 3 to 4 mg/L, 20 to 40 mg/L and 0.20 to 1 mg/L, respectively. In addition, the surface overflow rate given is the generally accepted maximum value for this process. Note that the other unit process design assumptions are about 60% to 70% of the generally accepted maximum values. As a result, the Actiflo process is likely smaller as compared to the other processes because of these assumptions, which means that its construction and operational costs may be low. And, if the chemical feed and sand replacement costs are not included (the replenishment and usage rates are not provided in the O&M assumptions), then both the capital and operational costs would increase for these items.

- Ozone. The assumed ozone dose is lower than expected given the water quality. This is clearly demonstrated by the Ozone Evaluation completed in the Phase 3 Report where the apparent demand (applied dose minus the residual) is 4 mg/L or more in just the one test performed. Using a low dose may have led to lower capital and operational costs for the ozone system.

- Membranes. The assumed instantaneous flux of 30 gallons per square foot per day (gfd) and recovery of 93% are low. The design flux (which should be about 60% to 80% of the instantaneous flux) for low pressure membranes in this application will range from 45 to 60 gfd per the pilot study conducted at the New Boston Road WTP by HDR. By assuming lower than normal values, the membrane system capital and operational costs shown may be high.

- Granular Activated Carbon (GAC) Contactors. The replacement frequency is assumed to be twice per year. Even though the proposed empty bed contact time is high (17.5 minutes), the clarified water quality that will pass through the GAC contactors has a high total organic carbon level (greater than 5 mg/L), and the probable replacement frequency will be between 2 and 3 months as indicated in the GAC process description in the TM. This replacement frequency is based on other operating facilities in the area. With the lower frequency used in the Report, the annual operational costs given may be low.

- The TM mentioned that the flood plain substantially impairs the use of the existing New Boston Road WTP site. However, there was no mapping included in the Memo, so HDR requested the flood plain mapping for the site from CH2M Hill. After receiving and reviewing the requested mapping, HDR agrees that the site is impaired by the flood plain. However, there is no need to purchase additional property as mentioned in the Report. A new 20-mgd treatment facility could be constructed within the existing footprint of the sedimentation basins, replacing the existing facility. Additional capacity above 20 mgd required for both the District's and TWU's customers could come from an expanded Millwood WTP, which is discussed later, or a new 40-mgd-ultimate plant to the west could be added at a later date.

Advantages and Disadvantages of the Treatment Process Alternatives

From HDR's review, advantages and disadvantages to the City for each of the proposed improvement alternatives are as follows:

- Treatment Train No 1 (Ozone and biologically activated carbon (BAC). As stated in the TM, this treatment train is capable of producing treated water that meets the Finished Water Goals (Goals). The report also states that this train has low capital and operating costs and is simple to operate and maintain. It is our experience that the ozone and BAC processes do not have low capital and operating costs and are not simple processes to operate given the general operator capabilities of the area. Ozone, for instance, generally has a high O&M cost because of the amount of energy needed to create ozone from ambient air or to purchase liquid oxygen. In addition, there is a strong potential for ozonated disinfection byproducts (DBPs) to form that may be problematic in the long term. A single test was performed to determine the potential ozone/DBP impact, and it showed that there would be no problems. However, bromide is present in the raw water and will react with ozone to form bromate (e.g., the ozone DBP). While the one test was successful, this potential problem could arise during the long term operation of the plant and must be considered as one of the deterrents to using ozone. Based on our experience, we would expect that the probable capital cost of this alternative as compared to the selected alternative would be slightly higher, which corresponds with the relative costs given in the Report.

- Treatment Train No. 2 (MF/UF - UV/AOP). Like No. 1, this treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train is complicated and is more automated than most processes. Generally, the high level of automation does allow for less operational oversight, which translates into lower labor costs. There are more chemicals for the membrane and UV/AOP systems than in a typical surface water plant, but the costs generally are not that significant to the overall O&M budget. Without the detailed cost calculations, it is difficult to comment; however, as an example, the UV/AOP process can be operated in the disinfection-only mode the majority of the time (approximately 10 to 11 months of the year), which has a lower energy cost. The process can be operated in the UV/AOP mode only during taste and odor events (approximately 1 to 2 months of the year at most), which results in high energy and chemical costs during this period. The O&M cost assumptions do not indicate the proposed operation of the UV/AOP system. The O&M assumptions also indicate that the membranes will be replaced every 7 years. It is our experience that, if properly maintained and operated, membranes will need to be replaced every 10 to 15 years. The projected capital cost of this alternative is almost twice that of the selected alternative. Based on our experience, we would expect that the probable capital cost of this alternative as compared to the selected alternative would be slightly higher but not double.

- Treatment Train No. 3 (MF/UF – GAC). This treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train is complicated and is more automated than most processes. Generally, the high level of automation does allow for less operational oversight, which translates into lower labor costs. There are more chemicals for the membrane system than in a typical surface water plant, but the costs generally are not that significant to the overall O&M budget. In addition, the GAC will have to be replaced when its adsorptive capacity is exhausted. To reduce complexity and cost, we suggest that a split stream treatment option (i.e., treat only a portion of the flow and blend back to meet finished water goals) should be explored. This arrangement may allow for downsizing of the GAC system for organic removal. However, depending on the taste and odor levels present, the entire plant flow may have to pass through the GAC when taste and odor events occur in order to remove the offending compounds to the levels needed. GAC can typically remove taste and odor compounds long after it is exhausted from organic removal. Without some type of piloting, the GAC replacement costs are difficult to predict, but the O&M assumptions indicate that the GAC will be replaced twice a year, which is not unusual. The O&M assumptions also indicate that the membranes will be replaced every 7 years. It is our experience that, if properly maintained and operated, membranes will need to be replaced every 10 to 15 years. The projected capital cost of this alternative is almost twice that of the selected alternative. Based on our experience, we expect that the probable capital cost of this alternative as compared to the selected alternative is higher but not double.

- Treatment Train No. 4 (Ozone – BAC/Actiflo) – Recommended Alternative. This treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train provides multiple barriers for total organic carbon (TOC) and taste and odor removals. One of the advantages indicated is that this treatment train is easy to operate, which is counter to HDR's experience with these processes. Ozone is part of this process train, and the concern noted above about ozonated DBPs is a potential problem that must be addressed. The Actiflo and ozone processes generally require a higher level of attention than other treatment processes. For instance, the proper amount of sand and the appropriate polymer dose must be maintained in the Actiflo process for it to operate properly. In the O&M assumptions, there is no indication that sand replacement costs are included. Our experience is that 5% to 8% of the sand must be replaced monthly. The ozone process must have the proper air preparation at all times to operate properly and efficiently. At this size of facility, liquid oxygen is commonly used for ozone generation, which would decrease the attention required over an ambient air generation system. The O&M assumptions do not indicate if liquid oxygen or ambient air is being used. Ambient air systems require air preparation equipment that is expensive and requires operation and maintenance attention that does not appear to be included in O&M costs. The projected capital cost of this alternative is almost twice that of the lowest. Based on our experience, we would expect that the probable capital cost of this alternative as compared to some of the other alternatives is actually equal to or slightly more.

- Treatment Train No. 5 (Ozone – BAC/Super P). This treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train provides multiple barriers for TOC and taste and odor removal. Ozone is part of this process train, and the concern noted above about ozonated DBPs is a potential problem that must be addressed. The Super P process is a tried and tested clarification process that generally works well in all conditions. This train is very similar to Train No. 4 as far as construction and operational costs, although it generally costs less to operate, primarily because the Super P process does not have the sand requirements of the Actiflo process.

- Treatment Train No. 6 (Ozone – BAC/solids contact). This treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train provides multiple barriers for TOC and taste and odor removal. Ozone is part of this process train, and the concern noted above about ozonated DBPs is a potential problem that must be addressed. The Densadeg process is a clarification process that has been used for some time and works well with challenging water sources. This train is very similar to Train No. 4 as far as construction and operational costs, although it generally costs less to operate, primarily because the Densadeg clarifier does not have the sand requirements of the Actiflo process.

- Treatment Train No. 7 (Existing Treatment Process). As noted in the TM, the existing process cannot meet the taste and odor requirements of the Goals, which has been demonstrated in the past. However, this process does meet all the other requirements of the Goals.

Advantages and Disadvantages of the Water Treatment Plant and Raw Water Intake Sites

From HDR's review, advantages and disadvantages to the City for the sites evaluated for the new water treatment facility and raw water intake are as follows:

- Only one intake site was evaluated. Evaluating only one site makes it difficult to make cost comparisons for the WTP sites in or near the City of Texarkana. HDR believes there is at least one other site that could reduce the raw water transmission line distance to the site in or near the City of Texarkana as discussed later.

- Given the recommended intake location, the WTP site selection becomes somewhat biased to sites in its vicinity given the existing topography and potential raw water transmission line routing.

- The evaluation criteria analysis also seems biased to sites in the area. For instance, the existing New Boston Road WTP was severely discounted for social concerns and site ownership because of the flood plain issue. However, no consideration was given for constructing a new WTP within the existing site to replace its present capacity and then utilizing the Millwood WTP or a new WTP at one of the western locations for future capacity needs.

Other Peer Review Observations

From HDR's review, we offer the following:

- Treatment process selection appears to be based on treating Wright Patman Lake water to the levels required to have zero consumer aesthetic complaints as well as meet future anticipated regulatory requirements. The proposed treatment process meets those requirements. However, there could be a substantial savings in both capital and annual operational costs if the treatment process is not designed to treat the extreme events that have occurred. For instance, based on our knowledge of the Texarkana Water Utilities historical records, there have been two significant taste and odor events in the last 20 to 30 years. Generally, there is very little taste and odor problem in the source water and, if there is an event, it is a relatively mild event with minimal consumer complaints. So, the treatment process as presented is designed to accommodate the most extreme event that has occurred. During normal operation, the proposed treatment process will be "over-treating" the water or the operators may bypass the treatment process(es) that are not necessary, allowing the equipment to sit idle because of the high operational cost. If the equipment sits idle for an extended period, then the equipment may not work when the design (i.e., extreme) event occurs.

- There appears to be another intake site location for the existing New Boston Road WTP to obtain water at a deeper level. For instance, in an area directly east of the chosen location near the dam, the shore and lake topography appears to be more amenable for a submerged intake and on-shore pump station as the length of the submerged intake will be shorter. The raw water line could be routed north along the existing roadways up to the existing raw water line into the New Boston Road WTP. The raw water transmission line from this location would be less than that from the chosen location to the New Boston Road WTP.

- No consideration is given to the Millwood WTP, which is the other WTP operated by Texarkana Water Utilities (TWU). The Millwood WTP source water quality is much better than Wright Patman Lake. In the past there have been no taste and odor problems from this water, and the organic levels are significantly less than in Wright Patman. Based on these characteristics, it appears there would be no need for the extensive treatment process such as those proposed in the Report to mitigate taste and odor events or control disinfection byproducts. There is land available to expand on the Millwood site to meet future water demands of the area. As we understand from past communications, water rights are still available to meet the projected demands. TWU has also utilized only the Millwood WTP to produce treated water for an extended time when it was necessary to shut down the New Boston Road WTP for maintenance. TWU is fully capable of meeting the current area demands utilizing only the Millwood WTP.

If you have any questions regarding this Peer Review, please feel free to call us at (972) 960-4440. HDR thanks the City for the opportunity to provide input into this important project for the City and the surrounding area.

Sincerely,

HDR ENGINEERING, INC.

Joel R. Cantwell, P.E.
Associate Vice President

STATE OF TEXAS
JOEL R. CANTWELL
86209
LICENSED
PROFESSIONAL ENGINEER

3/21/12

cc: Edward Motley, CH2M Hill
Mark Graves, HDR
Roger Noack, HDR

Appendix B
CH2M HILL Resolution to
HDR Engineering, Inc. Peer Review
May 7, 2012

CH2M HILL
12750 Merit Drive
Suite 1100
Dallas, TX 75251
(972) 980-2170
(972) 385-0846

May 7, 2012

Joel Cantwell, P.E.
HDR, Inc.
17111 Preston Rd.
Suite 200
Dallas, TX 75248-1232

RE: Peer Review of Riverbend Water Resources District Phase 3 Report on Water Treatment Plant and Raw Water Intake Site Selection

Mr. Cantwell,

We appreciate your comments on our Riverbend Water Resources District Phase 3 Report on Water Treatment Plant and Raw Water Intake Site Selection. We also appreciate you taking the time to meet with us to discuss your comments on April 17, 2012. This letter is a follow up to that meeting to review HDR's peer review comments (copy attached) on our report.

To summarize your statement at our meeting, HDR did not have any major technical issues with the work completed by CH2MHILL. However, certain project goals that became a part of CH2MHILL's scope of work impacted the project costs, namely the desire for more rigorous taste and odor control and a more reliable raw water intake system. We did agree that differences between our report and previous reports completed by HDR were a matter of scope rather than major differences of opinion. Your scope was focused on extending the life of the New Boston Road Water Treatment Plant. Our scope was focused on providing a long term water supply to the Riverbend Water Resources District. As a result of these differing scopes of work, we reached differing conclusion, but as I understand your comments and our discussion, HDR does not have any strong disagreements with our conclusions given our scope of work.

Following is a detailed summary of our discussions relating to your comments and the details of the conclusions that I understand we agreed upon:

- *The finished water quality will be very different from that currently produced by the New Boston Road WTP. In particular, the oxygen reduction potential (ORP) will be higher from the proposed WTP because of the ozone disinfection process proposed for the new plant. The existing WTP does not use any process that imparts a significant amount of oxygen into the finished water. This change may have an unintended interaction with the existing scale in the City's distribution system (and for that matter all of the District's member cities' distribution systems). This could lead to the release of the existing scale which may cause colored water at the consumer's tap.*

CH2MHILL and other engineers have successfully deployed the recommended process (coagulation/flocculation /sedimentation, ozonation, biologically active carbon (BAC) filters) in water similar to the Wright Patman raw water for over 20 years. The critical success factors to avoid any distribution system issues are to produce biologically and chemically stable water. The BAC filters will ensure biologically stable water. Chemically stable water will be produced by carefully balancing the pH and mineral content of the water producing a positive langelier index. Twenty years of experience has shown us that ORP will not be an issue as long as the water is both chemically and biologically stable.

- *Looking at the costs presented in the Phase 3 Report, it was difficult for HDR to comment on any of the costs, either capital or operation and maintenance. Therefore, HDR requested additional information from CH2M Hill, and the Technical Memorandum on Evaluation of Treatment Alternatives, dated December 1, 2009 (hereafter referred to as TM), was shared with HDR. Based on our review of the additional information, the capital and operation and maintenance costs for all of the alternatives were generated by CH2M Hill's Parametric Cost Estimating System (CPES), and only the assumptions that were used for the model are provided. Therefore, HDR cannot comment on how the costs were developed, but we offer the following comments on the assumptions and how those assumptions may affect the capital and operational costs provided.*

    - *<u>Rapid Mix</u> - Per Texas Commission on Environmental Quality (TCEQ) "Rules and Regulations," there must be at least two rapid mix basins. In addition, the velocity gradient given is more than twice the generally accepted maximum value".*

The report was intended as a conceptual design document to conservatively identify the size of the facilities so that water treatment plant site needs could be evaluated and projected costs developed for the future facilities. The report was not intended as a design report document and did not go into detail on the number of units and the exact design parameters (such as mixing velocity gradients). These details will be evaluated and addressed in a preliminary design report. However, the CPES evaluation did include two rapid mix trains in the analysis. The velocity gradient, although higher than often used in rapid mixing applications, was chosen to give conservative cost values that were applied to all alternatives and will be further evaluated during final design. The information assumed in the CPES Model does not materially impact the conclusions of the report.

- *<u>Flocculation</u>. The detention time is more than twice that required by TCEQ (i.e. 20 minutes) so the capital cost for flocculation may be high.*

As stated above, the report was intended as a conceptual design document to provide conservative data to identify the size of the facilities so that water treatment plant site needs could be evaluated and a projected cost developed for the new facilities. The report was not intended as a design report document and did not go into detail on the number of units and exact design parameters that will be used in the design. These details will be addressed in a preliminary design report. The assumptions used in the CPES model were applied to all of the alternatives. The information assumed in the CPES model does not materially impact the conclusions of the report.

- *<u>Actiflo</u>. The report does not indicate what the assumed sand replenishment, coagulant and polymer rates are, which generally are 3 to 4 mg/L, 20 to 40 mg/L and 0.20 to I mg/L respectively. In addition, the surface overflow rate given is the generally accepted maximum value for this process. Note that the other unit process design assumptions are about 60% to 70% of the generally accepted maximum values. As a result, the Actiflo process is likely smaller as compared to the other processes because of these assumptions, which means that its construction and operational costs may be low. And, if the chemical feed and sand replacement costs are not included (the replenishment and usage rates are not provided in the O&M assumptions), then both the capital and operational costs would increase for these items.*

The Actiflo analysis in CPES did include the sand, coagulant, and polymer dosages. The overflow rate of 22.5 gpm/ft2 is high but is still below the rate on other installations we have designed around the country and in the State of Texas. While it appears that Actiflo will provide some cost benefits to the District, the final decision on clarification technology will be made during the next phase of the design. Conceptual site layouts have been prepared based on conventional clarification which requires the largest site area.

- *<u>Ozone</u>. The assumed ozone dose is lower than expected given the water quality. This is clearly demonstrated by the Ozone Evaluation completed in the Phase 3 Report where the apparent demand (applied dose minus the residual) is 4 mg/L or more in just the one test performed. Using a low dose may have led to lower capital and operational costs for the ozone system.*

We will update our report to reflect a ozone dosage of 4 mg/l.

- *<u>Membranes</u>. The assumed instantaneous flux of 30 gallons per square foot per day (gfd) and recovery of 93% are low. The design flux (which should be about 60% to 80% of the instantaneous flux) for low pressure membranes in this application will range from, 45 to 60 gfd per the pilot study conducted at the New Boston Road WTP by HDR. By assuming lower than normal values, the membrane system capital and operational costs shown may be high.*

We understand from our discussion that the higher flux rates were achieved with the Pall membrane. The 30 gfd/ft2 noted in our assumptions was based on a submerged type membrane which typically operate at significantly lower fluxes than pressure membranes. Your findings are consistent with our experience that Pall membranes have a higher flux rate than other manufacturers, but the Pall membrane equipment comes at a premium cost. The submerged systems tend to have a lower equipment cost, but have the additional costs of basins. Thus the costs of the two types of are determined by the bidding market at the time of bids. Often, the Pall membranes will be more competitive; therefore, we will rerun our analysis based on a Pall flux rate of 60 gfd/ft2 and a submerged membrane flux rate of 40 gfd/ft2 and revise our costs accordingly to be consistent with your pilot findings.

- *<u>Granular Activated Carbon (GAC) Contactors</u>. The replacement frequency is assumed to be twice per year. Even though the proposed empty bed contact time is high (17.5 minutes), the clarified water quality that will pass through the GAC contactors has a high total organic carbon level (greater than 5 mg/L) , and the probable replacement frequency will be between 2 and 3 months as indicated in the GAC process description in the TM. This replacement frequency is based on other operating facilities in the area. With the lower frequency used in the Report, the annual operational costs given may be low.*

Only treatment alternative 3 uses GAC. This alternative is already significantly more expensive than most of the other alternatives. If the required replacement times are shorter, this cost disadvantage will only increase. Our recommended process does not utilize GAC. Our recommended process employs biologically active carbon (BAC) filters which do not require regeneration. The media in BAC filters typically require replacement at intervals similar to conventional multimedia sand and anthracite filters, approximately 10 to 15 years; therefore, the cost comparisons in the report accurately represent our recommendations.

- *The TM mentioned that the flood plain substantially impairs the use of the existing New Boston Road WTP site. However, there was no mapping included in the Memo so HDR requested the flood plain mapping for the site from CH2M Hill. After receiving and reviewing the requested mapping, HDR agrees that the site is impaired by the flood plain. However, there is no need to purchase additional property as mentioned in the Report. A new 20-mgd treatment facility could be constructed within the existing footprint of the sedimentation basins, replacing the existing facility. Additional capacity above 20 mgd required for both the District's and TWU's customers could come from an expanded Millwood WTP, which is discussed later, or a new 40-mgd-ultimate plant to the west could be added at a later date.*

There is a small portion of the existing plant site that sits outside of the flood plain, but even the existing sedimentation basins and clear wells sit in the flood plain. HDR noted that these facilities could be renovated in place, requiring appropriate sealing of the clear wells to prevent flood water from contaminating the water supply during a flood event however; it will be difficult to establish a clearwell overflow elevation above the floodplain while maintaining the hydraulic profile through the treatment plant.

Even if the New Boston Road Plant could be renovated in a manner that assured a safe water supply during a flood event, any additional future capacity would have to be constructed at another location (Millwood or a new site). Construction of additional capacity at Millwood will require obtaining additional water rights from Millwood and resolving interstate water rights issues between the States of Texas and Arkansas. Adding capacity at a new site will result in the additional operating and overhead expenses for three plants instead of two. Furthermore, the costs HDR has projected for New Boston Road Plant renovations do not include the costs of the flood plain mitigation.

Advantages and Disadvantages of the Treatment Process Alternatives
From HDR's review, advantages and disadvantages to the City for each of the proposed improvement alternatives are as follows:

- *Treatment Train No 1 (Ozone and biologically activated carbon CBAC). As stated in the TM, this treatment train is capable of producing treated water that meets the Finished Water Goals (Goals). The report also states that this train has low capital and operating costs and is simple to operate and maintain. It is our experience that the ozone and BAC processes do not have low capital and operating costs and are not simple processes to operate given the general operator capabilities of the area. Ozone, for instance, generally has a high O&M cost because of the amount of energy needed to create ozone from ambient air or to purchase liquid oxygen. In addition, there is a strong potential for ozonated disinfection byproducts (DBPs) to form that may be problematic in the long term. A single test was performed to determine the potential ozone/DBP impact, and it showed that there would be no problems. However, bromide is present in the raw water and will react with ozone to form bromate (e.g., the ozone DBP). While the one test was successful, this potential problem could arise during the long term operation of the plant and must be considered as one of the deterrents to using ozone. Based on our experience, we would expect that the probable capital cost of this alternative as compared to the selected alternative would be slightly higher, which corresponds with the relative costs given in the Report.*

The ozone process does have a higher energy cost than that of the current disinfection alternative (chloramines), but ozone is a much more effective disinfectant than chloramines alone (chloramines will remain as a secondary disinfectant).

Our tests show that bromate formation is low using ozone with Wright Patman water. Further tests will be conducted during design and will be used to confirm that. There are a number of bromate control strategies that can be implemented at the plant if water quality conditions change in the future. Many facilities treating northeast Texas water currently use the ozone process successfully. The process will be designed with measures to control any bromate formation that may be experienced in the future.

Control of ozone processes are no more sophisticated than controlling membrane filters. Both have been included in automated plants that are run remotely. Like membrane filters, automated control systems can be employed at ozone plants to reduce operator workload. As with any new process (ozone, membrane filters, UV/AOP) operator training will be required.

With the exception of adjusting the assumed ozone dosage rates, the report fairly presents a comparative cost of this alternative relative to others.

- *Treatment Train No. 2 (MF/UF - UV/AOP). Like No.1, this treatment train is capable of producing treated water that meet the Goals. As noted in the TM, this train is complicated and is more automated than most* *processes. Generally, the high level of automation does allow for less operational oversight, which translates into lower labor costs. There are more chemicals for the membrane and UV/AOP systems than in a typical surface water plant, but the costs generally are not that significant to the overall O&M budget. Without the detailed cost calculations, it is difficult to comment; however, as an example, the UV I AOP process can be operated in the disinfection-only mode the majority of the time (approximately 10 to 11 months of the year), which has a lower energy cost. The process can be operated in the UV/AOP mode only during taste and odor events (approximately 1 to 2 months of the year at most), which results in high energy and chemical costs during this period. The O&M cost assumptions do not indicate the proposed operation of the UV/AOP system. The O&M assumptions also indicate that the membranes will be replaced every 7 years. It is our experience that, if properly maintained and operated, membranes will need to be replaced every 10 to 15 years. The projected capital cost of this alternative is almost twice that of the selected alternative. Based on our experience, we would expect that the probable capital cost of this alternative as compared to the selected alternative would be slightly higher but not double.*

The membrane system would be designed with an automated control system, but our experience indicates that the level of automation and resulting operator attention would be about the same for membranes and UV/AOP as would be expected for the Treatment Train 1 process. Both processes require significantly different operator attention therefore additional training will be required for either Treatment Train 1 or Treatment Train 2.

The operating cost of the membranes would be more than the BAC filters and the cost of the UV/AOP oxidation process would be comparable to the ozone process; therefore, the operating cost of Treatment Train 2 is anticipated to be slightly more than Treatment Train 1.

The UV/AOP could be turned down or shut down during periods when taste and odor are not a big problem. Similarly, the ozone system could be turned down or shut down if Treatment Train 1 were implemented. This strategy would reduce costs, but the taste and odor of the water will change significantly when the UV/AOP or the ozone is turned off resulting in more customer complaints.

The report fairly presents a comparative cost of this alternative relative to others.

- *Treatment Train No.3 (MF/UF - GAC). This treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train is complicated and is more automated than most processes. Generally, the high level of automation does allow for less operational oversight, which translates into lower labor costs. There are more chemicals for the membrane system than in a typical surface water plant, but the costs generally are not that significant to the overall O&M budget. In addition, the GAC will have to be replaced when its adsorptive capacity is exhausted. To reduce complexity and cost, we suggest that a split stream treatment option (i.e., treat only a portion of the flow and blend back to meet finished water goals) should be explored. This arrangement may allow for downsizing of the GAC system for organic removal. However, depending on the taste and odor levels present, the entire plant flow may have to pass through the GAC when taste and odor events occur in order to remove the offending compounds to the levels needed. GAC can typically remove taste and odor compounds long after it is exhausted from organic removal. Without some type of piloting, the GAC replacement costs are difficult to predict, but the O&M assumptions indicate that the GAC will be replaced twice a year, which is not unusual. The O&M assumptions also indicate that the membranes will be replaced every 7 years. It is our experience that, if properly maintained and operated, membranes will need to be replaced every 10 to 15 years. The projected capital cost of this alternative is almost twice that of the selected alternative. Based on our experience, we expect that the probable capital cost of this alternative as compared to the selected alternative is higher but not double.*

We concurred with HDR's remarks; however, these remarks do not change the conclusions of the report. Membrane life is often a factor of the frequency of cleaning. Membranes run at a higher flux rate require more frequent cleanings and thus have a shorter life expectancy. This will need to be considered when selecting a design flux.

- *Treatment Train No. 4 (Ozone - BAC/Actiflo) - Recommended Alternative. This treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train provides multiple barriers for total organic carbon (TOC) and taste and odor removals. One of the advantages indicated is that this treatment train is easy to operate, which is counter to HDR's experience with these processes. Ozone is part of this process train, and the concern noted above about ozonated DBPs is a potential problem that must be addressed. The Actiflo and ozone processes generally require a higher level of attention than other treatment processes. For instance, the proper amount of sand and the appropriate polymer dose must be maintained in the Actiflo process for it to operate properly. In the O&M assumptions, there is no indication that sand replacement costs are included. Our experience is that 5% to 8% of the sand must be replaced monthly. The ozone process must have the proper air preparation at all times to operate properly and efficiently. At this size of facility, liquid oxygen is commonly used for ozone generation, which would decrease the attention required over an ambient air generation system. The O&M assumptions do not indicate if liquid oxygen or ambient air is being used. Ambient air systems require air preparation equipment that is expensive and requires operation and maintenance attention that does not appear to be included in O&M costs. The projected capital cost of this alternative is almost twice that of the lowest. Based on our experience, we would expect that the probable capital cost of this alternative as compared to some of the other alternatives is actually equal to or slightly more.*

The Actiflo O&M assumptions include sand and polymer costs. The ozone costs were based on a liquid oxygen generation system. Sand addition complicates the operation of the Actiflo system a little bit but any clarification process relies on accurate feed of coagulant and often times polymer. As stated earlier, we believe Actiflo has some significant cost benefits due to its high loading rates. However, a final selection of Actiflo versus conventional coagulation/sedimentation has not been made and plant layouts have been based on the more conservative conventional system. In general we concur with HDR's comments; however, the comments do not change the conclusions of the report.

- *Treatment Train No. 5 (Ozone - BAC/Super P) - This treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train provides multiple barriers for TOC and taste and odor removal. Ozone is part of this process train, and the concern noted above about ozonated DBPs is a potential problem that must be addressed. The Super P process is a tried and tested clarification process that generally works well in all conditions. This train is very similar to Train No. 4 as far as construction and operational costs, although it generally costs less to operate, primarily because the Super P process does not have the sand requirements of the Actiflo process.*

The Super P process has many of the same cost and process advantages as Actiflo. We have found Actiflo to respond better to rapid changes in flow rates and raw water quality and have been able to achieve higher overflow rates than with Super P. We agree that the Super P operating costs are lower than the Actiflo system, however when capital costs are figured in, the annual unit water costs are slightly lower for Actiflo. These remarks do not change the conclusions of the report.

- *Treatment Train No.6 (Ozone - BAC/solids contact) - This treatment train is capable of producing treated water that meets the Goals. As noted in the TM, this train provides multiple barriers for TOC and taste and odor removal. Ozone is part of this process train, and the concern noted above about ozonated DBPs is a .potential problem that must be addressed. The Densadeg process is a clarification process that has been used for some time and works well with challenging water sources. This train is very similar to Train No. 4* *as far as construction and operational costs, although it generally costs less to operate, primarily because the Densadeg clarifier does not have the sand requirements of the Actiflo process.*

We concurred with HDR's remarks; however, these remarks do not change the conclusions of the report.

- *Treatment Train No.7 (Existing Treatment Process) - As noted in the TM, the existing process cannot meet the taste and odor requirements of the Goals, which has been demonstrated in the past: However, this process does meet all the other requirements of the Goals.*

We concurred with HDR's remarks. This process is most similar that employed at the existing New Boston Road Plant. We will include costs for this process in our revised report so that Riverbend Water Resources District can be fully advised of the additional capital and operating costs of achieving the advanced taste and odor control.

Advantages and Disadvantages of the Water Treatment Plant and Raw Water Intake Sites
From HDR's review, advantages and disadvantages to the City for the sites evaluated for the new water treatment facility and raw water intake are as follows:

- *Only one intake site was evaluated. Evaluating only one site makes it difficult to make cost comparisons for the WTP sites in or near the City of Texarkana. HDR believes there is at least one other site that could reduce the raw water transmission line distance to the site in or near the City of Texarkana as discussed later.*

The recommended intake site was selected because it provided the deepest water along the north shore of the lake. The site suggest by HDR has a depth of approximately 208 FT. MSL. The recommended site has a bottom elevation of approximately 204 FT. MSL, thus providing an additional four feet of submergence for the intake. This additional submergence provides access to four feet more water than that suggested by HDR.

- *Given the recommended intake location, the WTP site selection becomes somewhat biased to sites in its vicinity given the existing topography and potential raw water transmission line routing.*

There was no bias in selecting the intake site or the water treatment plant site. The evaluation was objective and included the criteria and weighting factors discussed in advance of candidate site selection with Riverbend Water Resources District. The criteria and weighting factors was presented for open discussion by the public at two public meetings held in the Texarkana area in September of 2012. There were no concerns expressed by the public at the meetings.

- *The evaluation criteria analysis also seems biased to sites in the area. For instance, the existing New Boston Road WTP was severely discounted for social concerns and site ownership because of the flood plain issue. However, no consideration was given for constructing a new WTP within the existing site to replace its present capacity and then utilizing the Millwood WTP or a new WTP at one of the western locations for future capacity needs.*

The evaluation was objective and included the criteria and weighting factors discussed in advance of candidate site selection with Riverbend Water Resources District. The criteria and weighting factors was presented for open discussion by the public at two public meetings held in the Texarkana area in September of 2012. There were no concerns expressed by the public at the meetings.

Other Peer Review Observations
From HDR's review, we offer the following:

- *Treatment process selection appears to be based on treating Wright Patman Lake water to the levels required to have zero consumer aesthetic complaints as well as meet future anticipated regulatory requirements. The proposed treatment process meets those requirements. However, there could be a substantial savings in both capital and annual operational costs if the treatment process is not designed to treat the extreme events that have occurred. For instance, based on our knowledge of the Texarkana Water Utilities historical records, there have been two significant taste and odor events in the last 20 to 30 years. Generally, there is very little taste and odor problem in the source water and, if there is an event, it is a relatively mild event with minimal consumer complaints. So, the treatment process as presented is designed to accommodate the most extreme event that has occurred. During normal operation, the proposed treatment process will be "overtreating" the water or the operators may bypass the treatment process(es) that are not necessary, allowing the equipment to sit idle because of the high operational cost. If the equipment sits idle for an extended period, then the equipment may not work when the design (i.e., extreme) event occurs.*

Our interviews with the member cities during the Phase 1 Study indicated that taste and odor were a major concern of the member cities. The stability of chloramine residuals was another concern expressed by many members. Given the characteristics of Lake Wright Patman, a shallow lake with a high organic and nutrient load, tastes and odors are expected. Our recommended process was designed to address those taste and odor concerns as well as offering Riverbend Water Resources District with a modern treatment process that will be capable of meeting the projected water quality rules.

In order for the Riverbend Water Resources District's Board to make an informed decision, we will include the costs of a conventional water treatment process (Treatment Train 7) in the report. This information will inform the Board of the costs associated with providing the additional level of treatment.

- *There appears to be another intake site location for the existing New Boston Road WTP to obtain water at a deeper level. For instance, in an area directly east of the chosen location near the dam, the shore and lake topography appears to be more amenable for a submerged intake and on-shore pump station as the length of the submerged intake will be shorter. The raw water line could be routed north along the existing roadways up to the existing raw water line into the New Boston Road WTP. The raw water transmission line from this location would be less than that from the chosen location to the New Boston Road WTP.*

The site suggest by HDR has a depth of approximately 208 FT. MSL. The recommended site has a bottom elevation of approximately 204 FT. MSL, thus providing an additional four feet of submergence for the intake. This additional submergence provides access to four feet more water than that suggested by HDR.

- *No consideration is given to the Millwood WTP, which is the other WTP operated by Texarkana Water Utilities (TWU). The Millwood WTP source water quality is much better than Wright Patman Lake. In the past there have been no taste and odor problems from this water, and the organic levels are significantly less than in Wright Patman. Based on these characteristics, it appears there would be no need for the extensive treatment process such as those proposed in the Report to mitigate taste and odor events or control disinfection byproducts. There is land available to expand on the Millwood site to meet future water demands of the area. As we understand from past communications, water rights are still available to meet the projected demands. TWU has also utilized only the Millwood WTP to produce treated water for an extended time when it was necessary to shut down the New Boston Road WTP for maintenance. TWU is fully capable of meeting the current area demands utilizing only the Millwood WTP.*

Our scope of work was focused on securing a long term water supply for the Riverbend Water Resources District from Lake Wright Patman. We agree that Millwood offers much better quality water than Wright Patman, but the Wright Patman water quality is not uncommon or particularly difficult to treat. The recommended process is a modern one that has been applied broadly across the United States and is designed to treat a broad spectrum of water qualities and comply with current and projected water quality rules.

Millwood was not considered for a number of reasons. First, Millwood is in Arkansas. Increasing the quantity of water diverted from Millwood to Texas would require increasing the allowable diversion from Millwood and addressing interstate transfer of water between Arkansas and Texas. Second, abandoning the New Boston Road Plant without replacing its capacity in the proximity of Lake Wright Patman would result in effectively abandoning the water rights the member cities have paid for over time in Lake Wright Patman.

Joel, we believe our responses contained herein accurately reflect the results of our discussion on April 17. If not, please let us know.

We do appreciate HDR's efforts to review our report and your comments.

Sincerely:

Edward M. Motley, PE, BCEE
Vice President
CH2M HILL

CC: F. Larry Sullivan, Ed. D.
Clyde Siebman
Robert Murray, PE, MTG Engineers

Appendix C
Public Meetings and Comments

Riverbend Water Resources District
Phase 3 Study

May 23, 2011

W06200000004GNV

Agenda

- Overview of Previous Study Results
- Overview of Phase 3 Study Scope of Work
- Overview of Phase 3 Study Progress
- Questions

Our Charge

- Assess the condition and capacity of the entire existing water supply system
  - Raw water intake/pump station, Water treatment plant, water transmission system
  - Inspected New Boston Road WTP, TexAmericas WTP, and Wright Patman Raw Water PS
- Recommend the most cost effective water system improvements to meet the current and future needs of the member cities
  - Location of facilities, water treatment process, project phasing
- Recommendations should address all apparent issues related to the water supply system
  - Treated water quality, long term reliability, expandability

Overview of Previous Studies

- Raw Water Intake
  - Existing intake location too shallow
  - Intake pipeline capacity & condition in question
  - Existing pump station in need of renovation
  - Raw water transmission pipeline appears to be acceptable for now

Overview of Previous Studies

- Water Treatment Plant
  - Existing WTP in need of renovation
    - Configuration and condition of existing plant makes renovation not feasible
    - New plant most cost effective alternative
    - Should consider both existing plant site and new plant sites
  - Treatment process recommended that resolves taste & odor issues cost effectively
  - New plant should be planned for an ultimate capacity of 60 MGD but initial phase should be 20 MGD

Overview of Previous Studies

- Existing Member City Treated Water Transmission System
  - The existing Member City water transmission system can meet RWRD's near term needs for conveyance of water to the Member Cities.
  - Some minor improvements might be required

Overview of Phase 3 Scope of Work

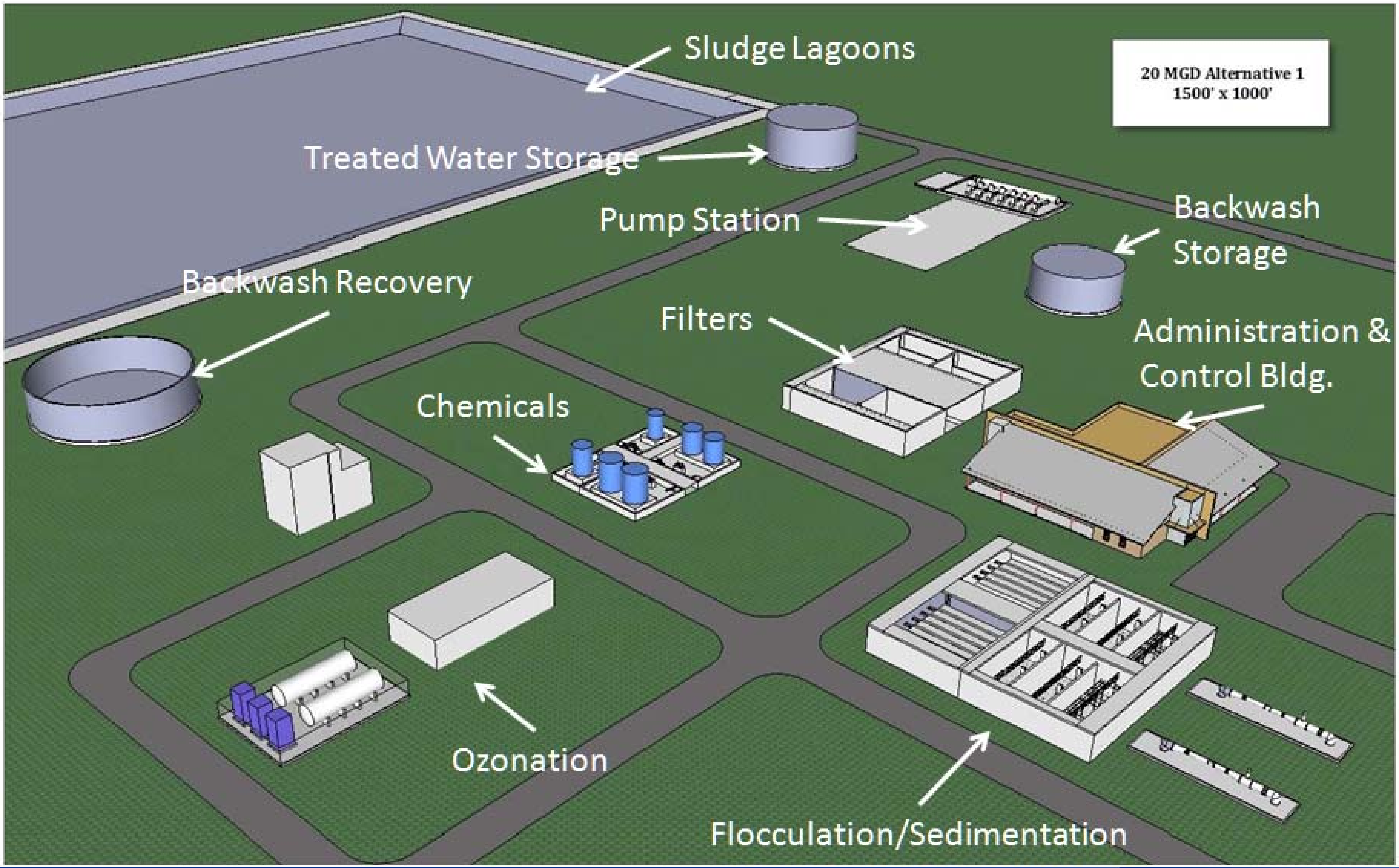
- Indentify Sites and Conceptual Designs for the New Water Supply Infrastructure
  - Raw Water Intake & Pump Station
  - Raw Water Pipeline
  - Water Treatment Plant
  - Treated Water Conveyance
- Validate the Water Treatment Process Assumptions Made in Phase 2 Studies
- Quantify the Projected Costs of the Infrastructure

Overview of Phase 3 Scope of Work

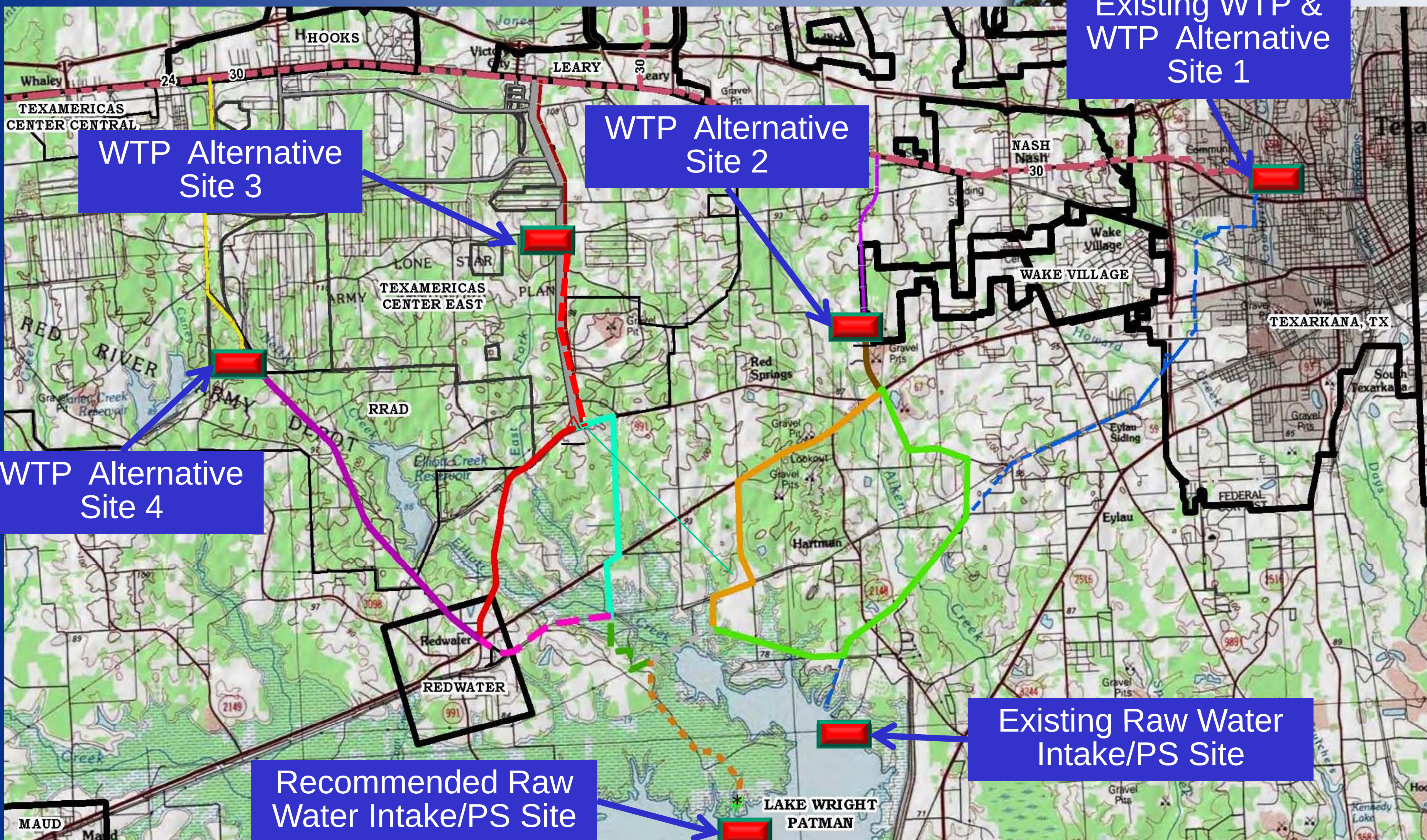
- Deliverables
  - Conceptual Site Plans for New Facilities
  - Conceptual Process Design for WTP
  - Conceptual Water Transmission System Design
  - Permit Requirements for Facilities
  - Cost Projections for Facilities

Overview of Phase 3 Study Progress

Status of WTP Conceptual Design



Status of WTP and Raw Water Intake Site Selection



Next Steps

- Adapt WTP conceptual designs to alternative sites
- Develop Raw Water Intake/PS conceptual design
- Develop site specific costs for each alternative
  - Include raw water and treated water transmission costs
- Evaluate alternatives
  - Consider capital and operating costs
  - Consider future expansion issues
- Complete water quality evaluations
- Conduct two more public meetings
- Prepare report

Riverbend Water Resources District
Phase 3 Study
Public Meeting Number 2

New Boston – 9/12/2011
Texarkana – 9/13/2011

Meeting Overview

- Overview of Previous River Bend Water Resource District (RWRD) Study Results
- Overview of Phase 3 Study Scope of Work
- Overview of Phase 3 Study Progress
- Public Comment

Acknowledgements

- This phase of studies is funded in part the Texas Water Development Board

Scope of Phase 1 RWRD Study

- Reviewed previous studies made available by RWR, TWU, etc.
  - **North East Texas (Region D) 2005 Regional Water Plan**
  - **System Operation of Lake Wright Patman,** Freese & Nichols, 2003
  - **TWDB Regional Water Planning Database** (Downloaded from TWDB Dec. 2008)
  - **TCEQ Water Rights Database** (Downloaded from TCEQ Dec. 2008)
  - **Chemical System Evaluation,** HDR, Nov. 20007
  - **Taste & Odor Study using Ultraviolet Light and Hydrogen Peroxide,** Trojan Technologies, April 2008

Scope of Phase 1 RWRD Study (Cont.)

- Reviewed previous studies made available by RWR, TWU, etc. (Cont.)
  - **Water Distribution System Master Plan**, APAI, March 2008
  - **Water Distribution Study** – Texarkana Texas, MTG/Pitometer Assoc., April 1999
  - **Wright Patman Water Treatment Plant Near-Term Process Evaluation**, HDR, October 2008
  - **Wright Patman Water Treatment Plant – Raw Water Conveyance System – TM3**, HDR, June 2008
  - **Wright Patman Water treatment Plant – New Water Treatment Facilities**, HDR, June 2008
  - **Draft Protocol for Membrane Pilot Testing**, HDR, August 2007
  - **Memo to Membrane System Suppliers**, HDR, January 2007
  - **CLB Engineers – Structural Integrity Analysis of Existing Concrete Structures located at Wright Patman Water Treatment**, CLB Engineers, June 2005
  - **TWU Agreements/Contracts/Permits** (20+ documents)

Scope of Phase 1 RWRD Study

- Interviewed RWRD Member Cities and assessed the condition and capacity of the existing RWRD water supply system
  - Raw water intake/pump station, water treatment plant, treated water transmission system
  - Inspected New Boston Road WTP, TexAmericas WTP, and Wright Patman Raw Water Pump Station
- Made recommendations for the scopes of additional studies (phased approach).

Scope of Phase 2 RWRD Study

- Studies focused on RWRD Member Cities System
- Recommended the most cost effective water system improvements to meet the current and future needs of the RWRD Member Cities
  - Water treatment process and project phasing
- Made recommendations to address issues related to the RWRD water supply system
  - Treated water quality, long term reliability, expandability

Overview - Phase 1 & 2 RWRD Studies

- Raw Water Intake
  - Existing intake location too shallow
    - Location is not reliable due to depth and continued siltation
  - Existing intake pipeline capacity & condition is in question
    - Siltation continues to impact
    - Not easily extended to water of reliable depth
  - Existing pump station in need of replacement
    - Structure is too shallow (doesn't allow for reliable flooded suction)
    - Equipment is at or beyond useful life

Overview - Phase 1 & 2 RWRD Studies

- Raw Water Intake (continued)
  - Existing raw water transmission pipeline,
    - Documentation of the condition of the pipeline has not been provided and/or is nonexistent
    - Capacity is inadequate for ultimate needs (60 MGD)
    - Capacity may be inadequate for current needs (20 MGD)

Overview - Phase 1 & 2 RWRD Studies

- Raw Water Systems
  - Intake
    - Needs to access deepest practical location in water source
    - Should make allowances for ultimate capacity (60 MGD)
    - Should make allowances for potential industrial raw water supplies
  - Pump Station
    - Structure should accommodate ultimate capacity and industrial raw water supply
    - Initially install Phase 1 capacity (20 MGD + Industrial Raw Water)
  - Raw Water Main
    - Initially construct Phase 1 capacity or greater
    - Obtain adequate easements/rights-of-way for ultimate capacity and industrial raw water supply

Overview - Phase 1 & 2 RWRD Studies

- Water Treatment Plant (WTP)
  - Existing New Boston Road WTP
    - Existing WTP facilities need to be replaced
  - New WTP
    - Should consider both existing plant site and new plant sites
    - Selection of the treatment process should be one that resolves taste & odor issues cost effectively
    - Ultimate treatment capacity of 60 MGD and initial phase capacity of 20 MGD

Overview - Phase 1 & 2 RWRD Studies

- RWRD Treated Water Transmission System
  - Provide as required the treated water infrastructure for initial phase capacity to the existing RWRD water transmission system (varies per site).
  - The existing RWRD water transmission system can meet near term needs for conveyance of water to the RWRD Member Cities.
  - Some improvements to the existing RWRD transmission system may be required for reliable operation.

Overview of Phase 3 RWRD/TWDB Study Work Scope

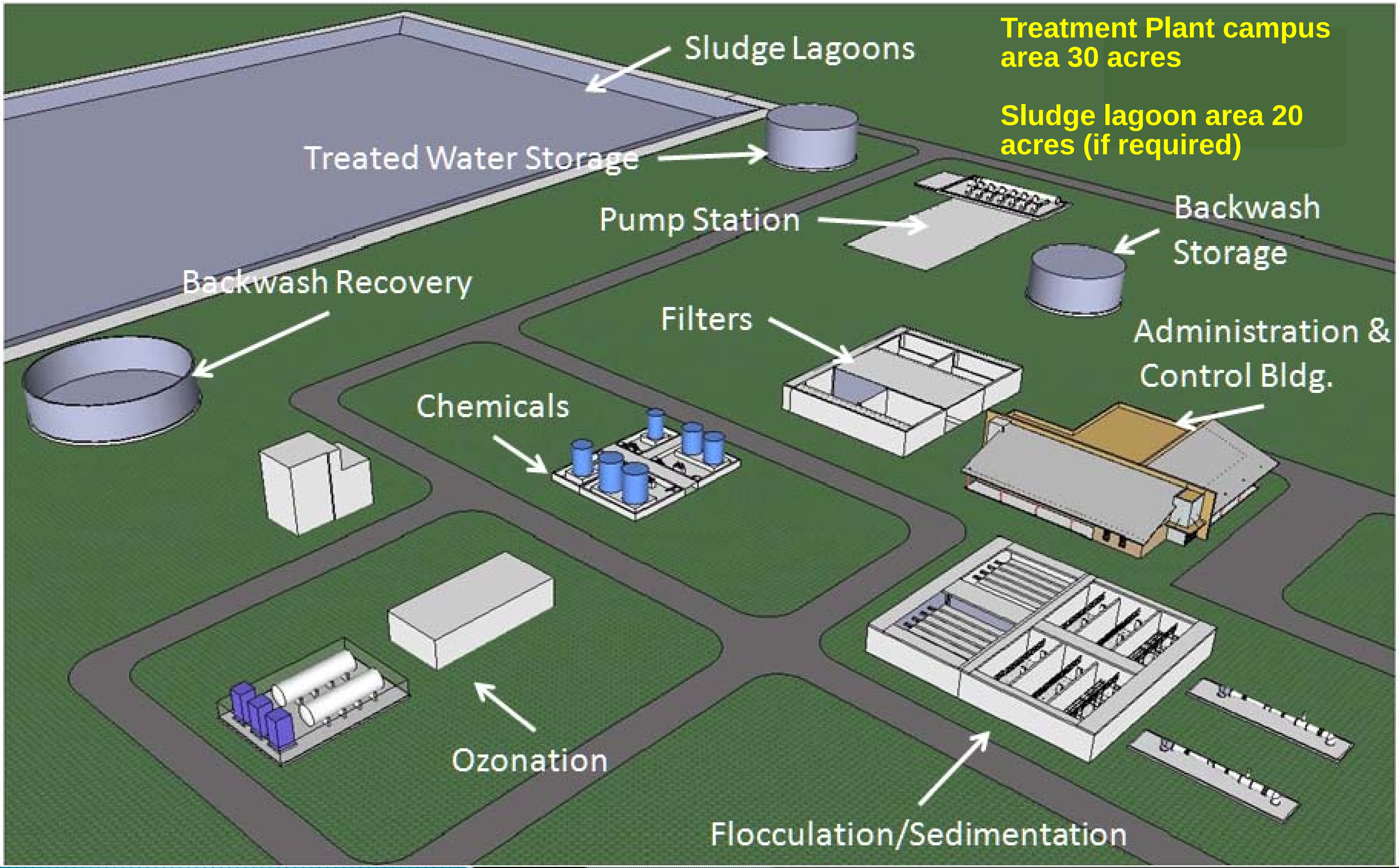
- Indentify Potential Sites and Conceptual Designs for the New Water Supply Infrastructure
  - Raw Water Intake & Pump Station
  - Raw Water Pipeline
  - Water Treatment Plant
  - Treated Water connection to the existing system
- Validate the Water Treatment Process Recommendations from the RWRD Phase 2 Studies

Overview of Phase 3
RWRD/TWDB Study Work Scope

- Estimate of Probable Total Cost for Each Site
- Deliverables
  - Conceptual Site Plans for New Facilities
  - Conceptual Process Design for WTP
  - Conceptual Water Transmission System Design (Raw & Treated)
  - Permit Requirements for Facilities
  - Cost Projections for Facilities

Overview of Phase 3
RWRD/TWDB Study Status

Status of WTP Conceptual Design



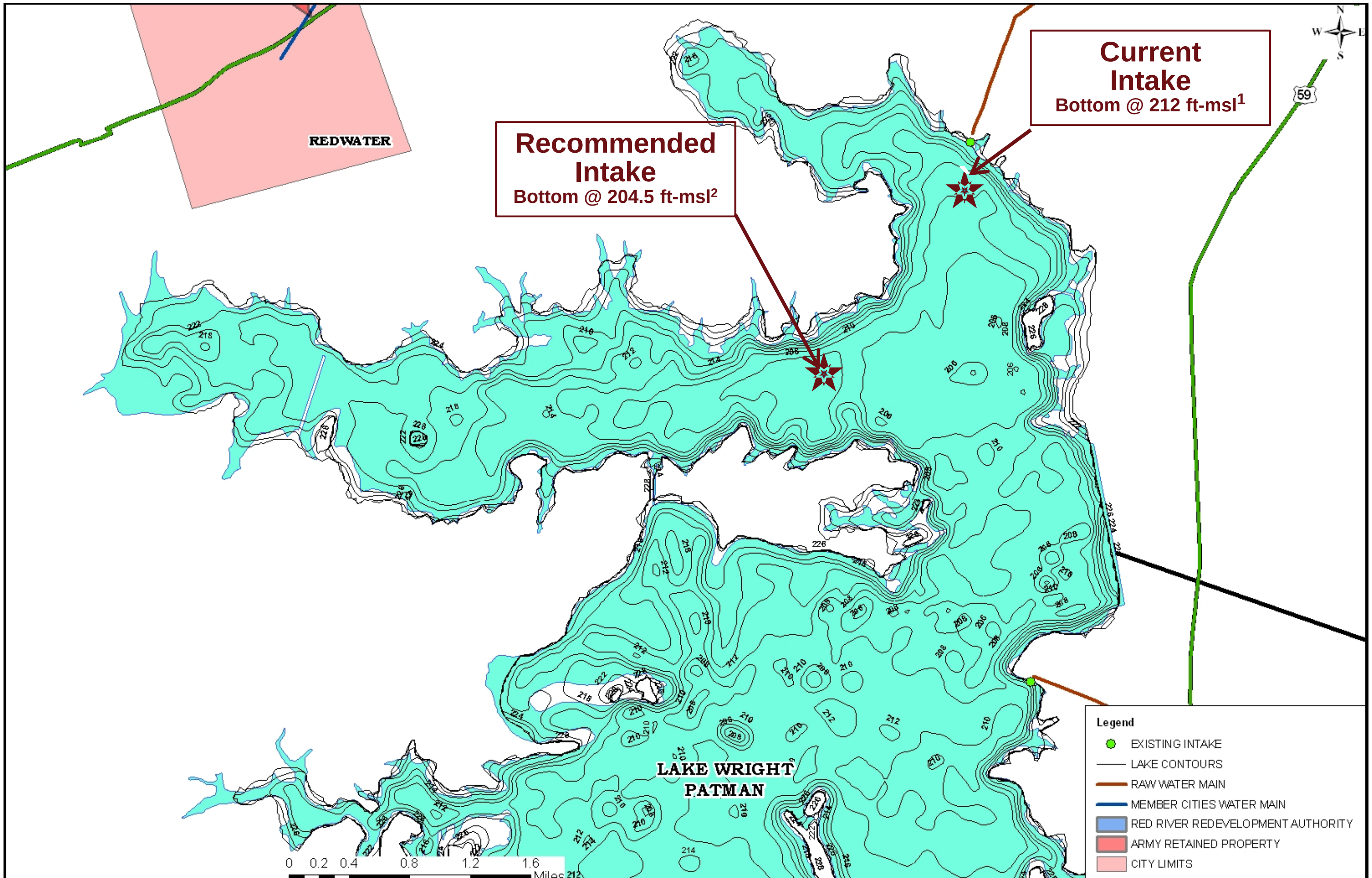
Water Treatment Plant Site Requirements

- Accessible
  - To major thoroughfares for daily deliveries of construction materials and water treatment supplies
  - To corridors to connect offsite infrastructure; raw water pipeline, treated water pipeline and power; etc.
- Environmental
  - No threatened and endangered species habitats
  - No protected areas such as wetlands or culturally significant sites
  - No unmitigated damage from previous land uses

Water Treatment Plant Site Requirements

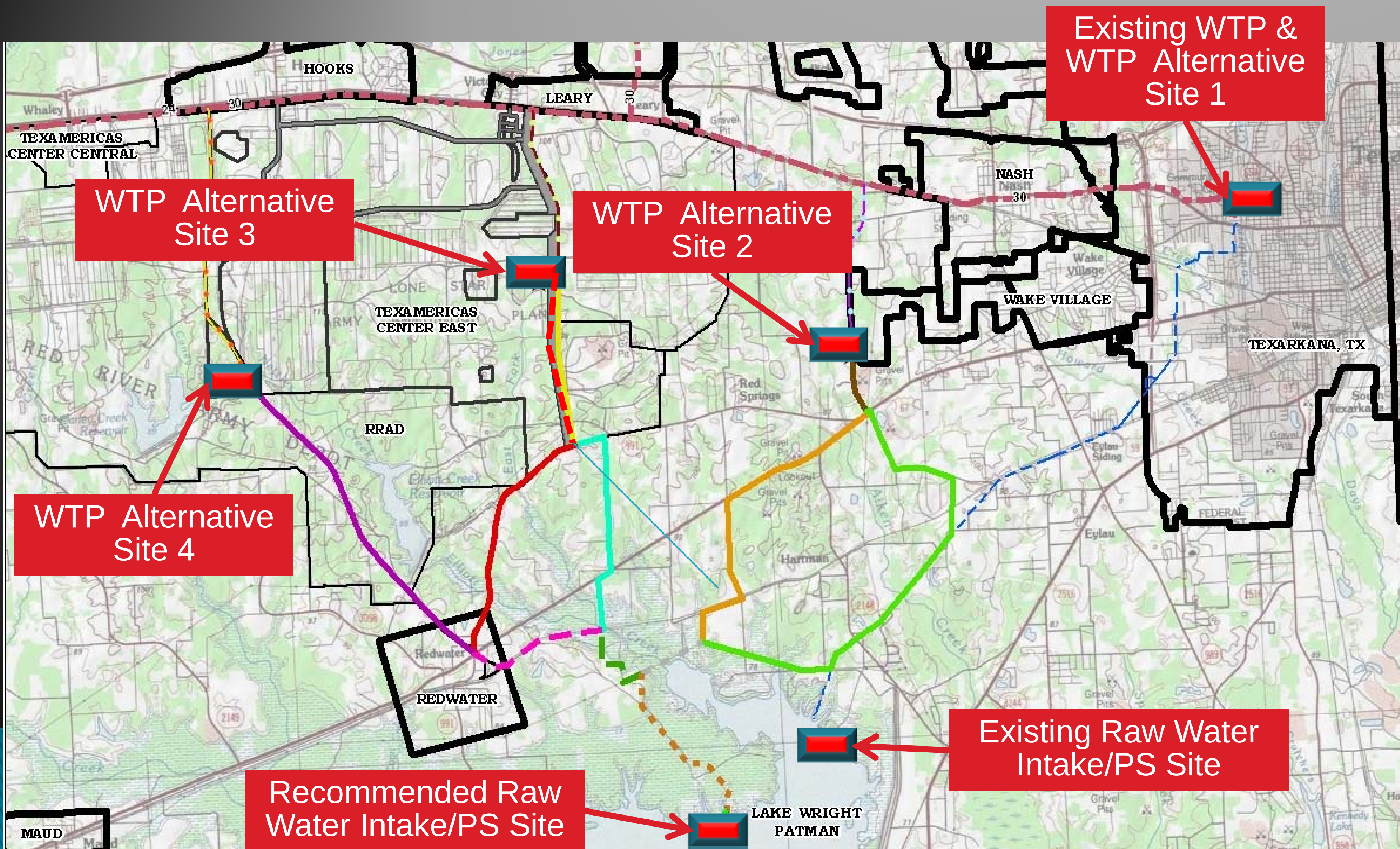
- Community
  - Consistent with existing and planned land uses (zoning)
  - Minimal traffic impacts to community from construction and operations traffic
- Site suitability
  - Area Requirements
    - At least 30 acres – Treatment Campus
    - At least 20 additional acres if sludge management is on site
  - Length to width ratio less than 3 to 1 is optimal
  - Gentle slopes (1% to 5% optimum)
  - Suitable foundation soils with no shallow ground water
  - No flood plain that constricts site use or access

Intakes & 1997 Bathymetry



1 Based on 2006 Survey by MTG
2 Based on 2010 Bathymetry Survey by TWDB

Status of WTP and Raw Water Intake Site Selection



Site Evaluation Process

- Each site assigned a scored for every criteria
- Criteria assigned a weighting factor
  - A – Most important
  - B – More important
  - C – Important
- Sites numerically ranked, highest score indicates the most desirable site

Site Evaluation Criteria

- Suitability
  - Area and configuration (A)
  - No floodplain restrictions (A)
  - Accessibility (B)
  - Power availability (B)
  - Permitting & zoning Requirements (B)
  - Topography (C)
  - Geotechnical considerations (C)
  - Easement/right-of-way needs (C)
- Economic Issues (A)
  - Construction costs including land & right-of-way
  - Operating costs
- Community Concerns (B)
- Environmental Impacts (B)

Next Steps

- Develop site specific costs for each alternative
- Evaluate alternatives
- Conduct third public meeting to present evaluation results & receive comments
- Prepare report

Riverbend Water Resources District
Phase 3 Study
Public Meeting Number 3

Texarkana- 5/21/2012
New Boston – 5/22/2012

Meeting Overview

- Review Previous Studies
- Overview of Phase 3 Study Scope of Work
- Overview of Phase 3 Study Conclusions & Recommendations
- Public Comment

Acknowledgements

- This phase of studies is funded in part the Texas Water Development Board

- HDR Engineering provided a peer review of the Phase 3 Report

Phase 1 & 2 Study Results

Existing System Capabilities & Condition

New Boston Road Plant……
Existing Conditions

Raw Water Intake

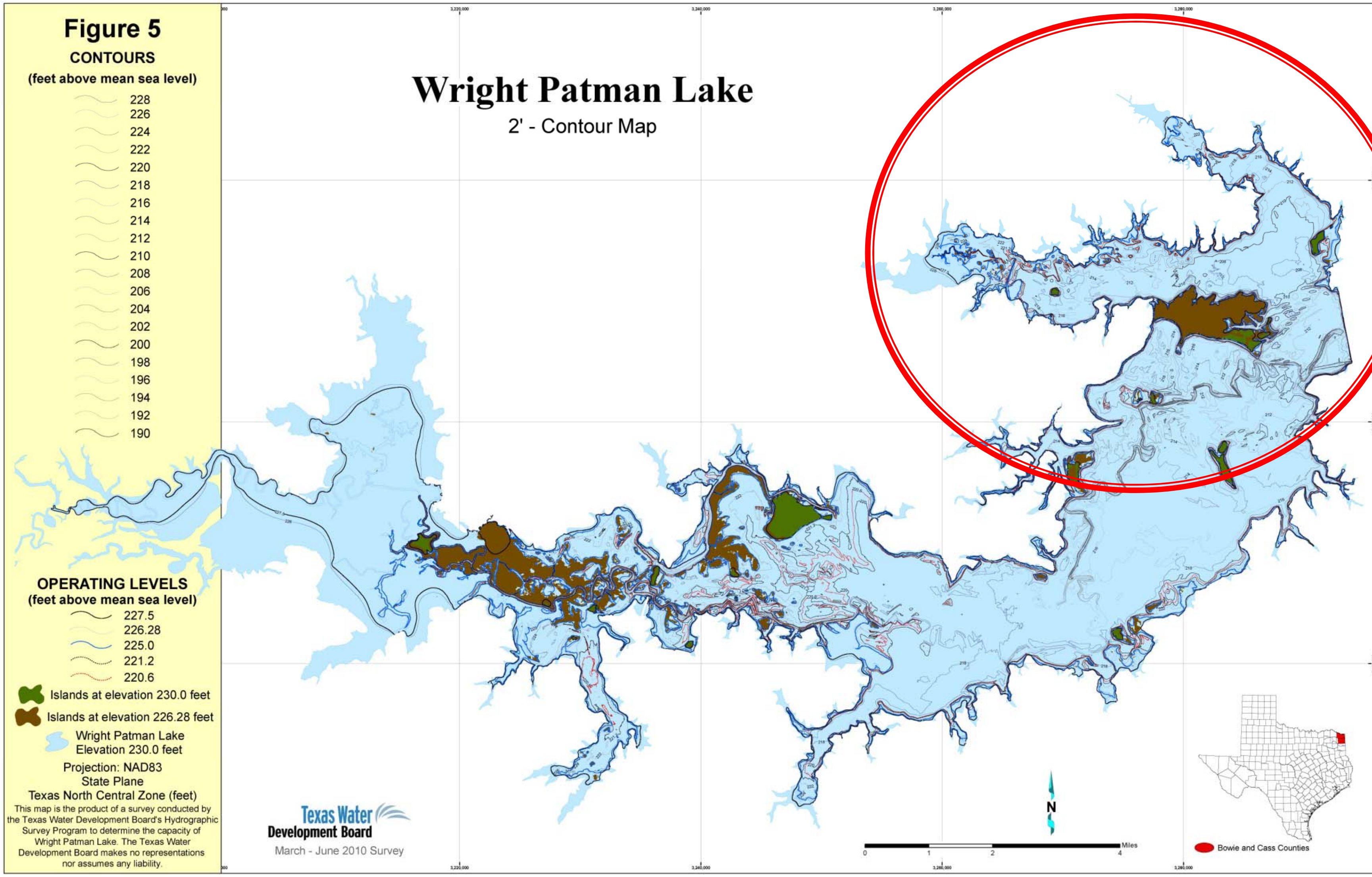
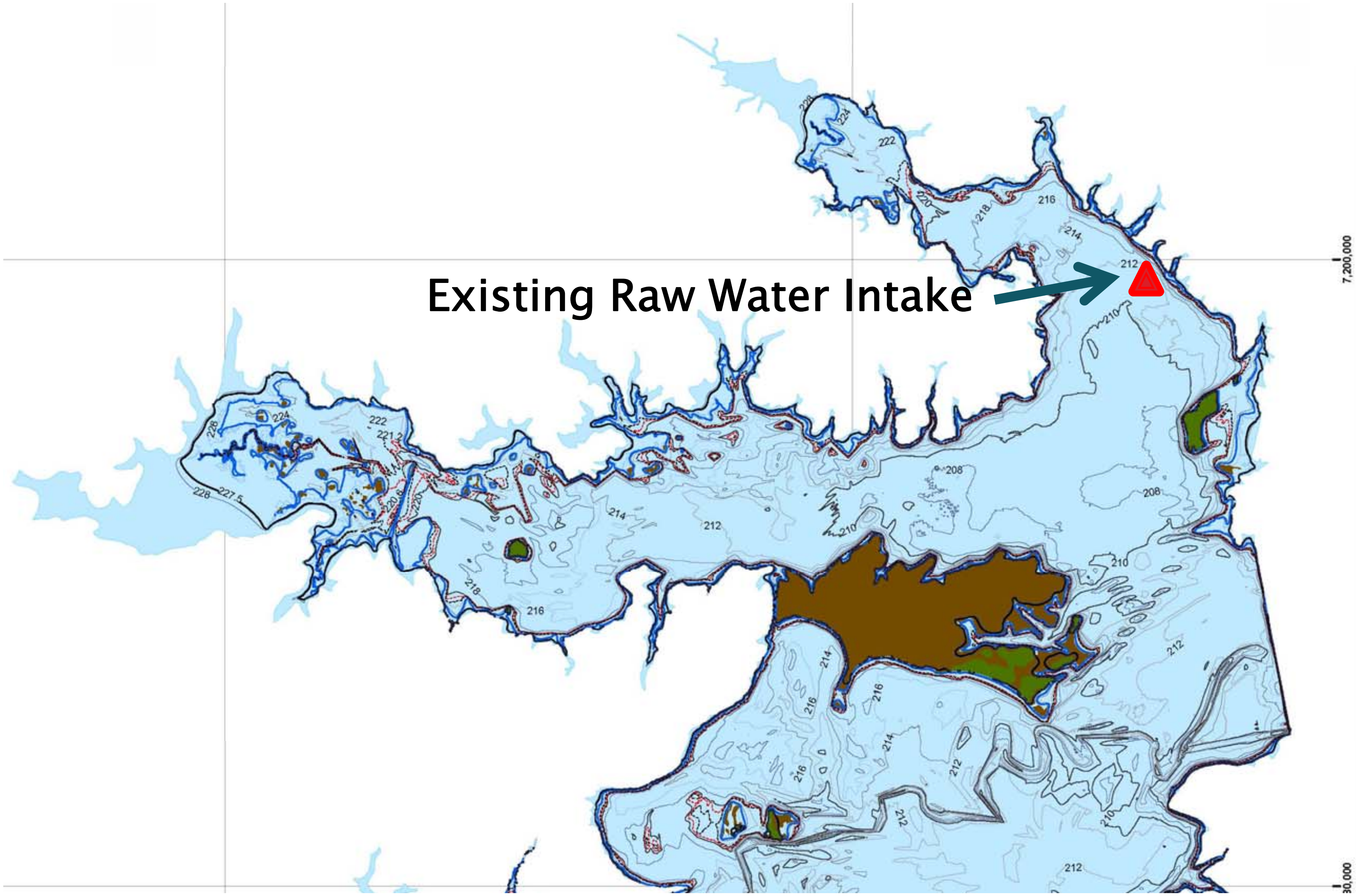
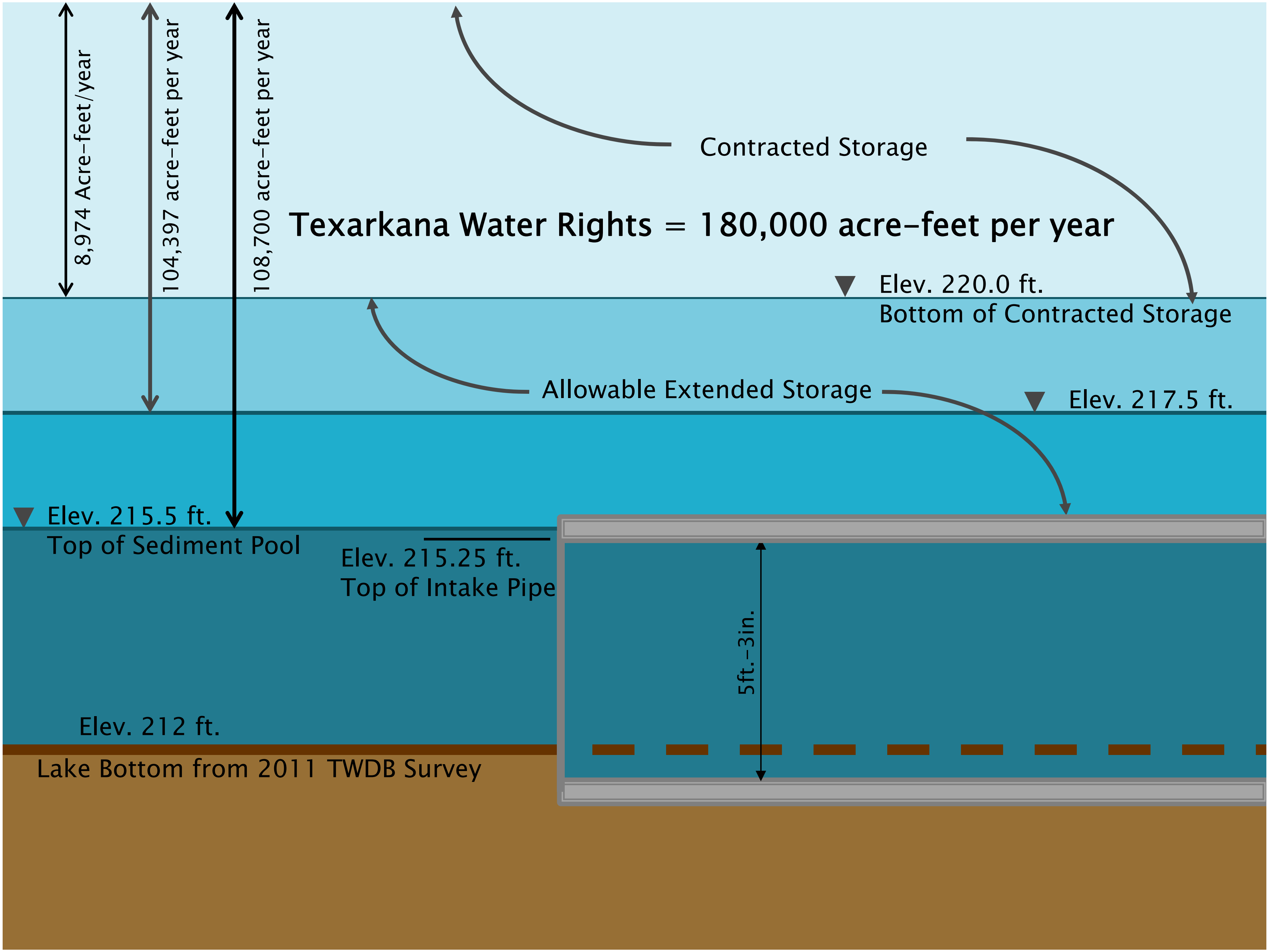


Figure 5
CONTOURS
(feet above mean sea level)
228
226
224
222
220
218
216
214
212
210
208
206
204
202
200
198
196
194
192
190
OPERATING LEVELS
(feet above mean sea level)
227.5
226.28
225.0
221.2
220.6
Islands at elevation 230.0 feet
Islands at elevation 226.28 feet
Wright Patman Lake
Elevation 230.0 feet
Projection: NAD83
State Plane
Texas North Central Zone (feet)
This map is the product of a survey conducted by the Texas Water Development Board's Hydrographic Survey Program to determine the capacity of Wright Patman Lake. The Texas Water Development Board makes no representations nor assumes any liability.
Wright Patman Lake
2' - Contour Map
Texas Water
Development Board
March - June 2010 Survey
N
Miles
0
1
2
4
Bowie and Cass Counties



Existing Raw Water Intake
7,200,000


8,974 Acre-feet/year
104,397 acre-feet per year
108,700 acre-feet per year
Contracted Storage
Texarkana Water Rights = 180,000 acre-feet per year
Elev. 220.0 ft.
Bottom of Contracted Storage
Allowable Extended Storage
Elev. 217.5 ft.
Elev. 215.5 ft.
Top of Sediment Pool
Elev. 215.25 ft.
Top of Intake Pipe
5ft.-3in.
Elev. 212 ft.
Lake Bottom from 2011 TWDB Survey

New Boston Road Plant……
Existing Conditions

- Raw Water Intake
  - Existing intake location too shallow
    - Location is not reliable due to depth and continued siltation
  - Existing intake pipeline capacity & condition is in question
    - Siltation continues to impact
    - Not easily extended to water of reliable depth
  - Existing pump station in need of replacement
    - Structure is too shallow (doesn't allow for reliable flooded suction)
    - Equipment is at or beyond useful life

New Boston Road Plant……
Existing Conditions

- Raw Water Intake (continued)
  - Existing raw water transmission pipeline,
    - Documentation of the condition of the pipeline has not been provided and/or is nonexistent
    - Capacity is inadequate for ultimate needs (60 MGD)
    - Capacity may be inadequate for current needs (20 MGD)

New Boston Road Plant……
Existing Conditions

Water Treatment Plant (WTP)


1 inch = 250 feet
BLANTON ST
LYONS ST
BORDER ST
N AKIN AVE
CONNELLA ST
OLLIE ST
CONNELLA ST
MARION ST
OAKLAWN DR
AVE A
AVE B
LUMPKIN ST
LUMPKIN ST
VIRGINIA AVE
AKIN AVE
WATERMAN ST
FEMA
ZONE AE
JEROME ST
FEMA
ZONE AE
FLOODWAY
MELTON ST
FEMA
ZONE AE
WILSON ST
NEW BOSTON RD
SMELSER ST

FLOOD PLAIN INFORMATION

DAYS CREEK AND TRIBUTARIES

TEXARKANA

ARKANSAS-TEXAS

PREPARED FOR
THE CITY OF TEXARKANA
BY
CORPS OF ENGINEERS, U. S. ARMY
NEW ORLEANS, LOUISIANA, DISTRICT
AUGUST, 1970

New Boston Road Plant……
Existing Conditions

- Water Treatment Plant (WTP)
  - Site
    - Sits largely within the 100 year floodplain
    - Adjacent to residential community
    - Little room for expansion
  - Existing WTP facilities 60 years old
    - Equipment needs replacement
    - Structures deteriorating
  - Finished water quality concerns
    - Taste & Odor
    - Disinfection stability
    - Disinfection by-products

Decision - Short Term Fix or Long Term Water Supply

- More up-front investment
- Future capital investment tied to growth
- Provides reliable water supply to meet:
  - Current needs
  - Supports future growth
- Improves quality of water delivered
  - Significantly reduce taste & odors
  - Assures disinfection residual to all customers
  - Reduces disinfection by-products to levels well below regulatory limits

Long Term Water Supply

- Less initial investment
- Future capital needed to fix remaining concerns
  - Raw water reliability (intake, pump station & pipeline)
  - Flood plain issues at the plant site
- Declining supply available to meet current needs, no plans for growth
- Does not fully address water quality concerns

Short Term Fix

Phase 3 Studies

Conceptual Planning for New Water Supply

Phase 3 Study Scope (Focus)

- Provide information to Riverbend Water Resources District:
  - Assume a new long term water supply with 20 MGD initial capacity and a 60 MGD ultimate capacity.
    1. What treatment process would cost effectively meet the Member's water quality goals…address taste & odor issues and provide a stable disinfection residual?
    2. Where would the optimum raw water intake be located that would afford reliable access to the entire conservation pool of Lake Wright Patman?
    3. Where would the optimum water treatment plant location be that would serve both the short term and long term water supply needs of the District's members?
    4. What would a new water supply system cost?

Phase 3 Study Scope (Focus)

- Study focused on developing a water supply from Lake Wright Patman because:
  - Focuses on rebuilding the Member City System.
  - Continue to use existing Texas Water Rights to supply Texas Member Cities.
  - Preserves existing Texas water rights from challenges if not used.
  - Does not require obtaining rights for interstate transfer of water from Arkansas to Texas.
    - A legislative issue for both States.

Overview of Phase 3 RWRD/TWDB Study Work Scope

- Indentify potential sites and conceptual designs for the new water supply infrastructure
  - Raw water intake & pump station
  - Raw water pipeline
  - Water treatment plant
  - Treated water connection to the existing system
- Validate the water treatment process recommendations from the RWRD Phase 2 Studies

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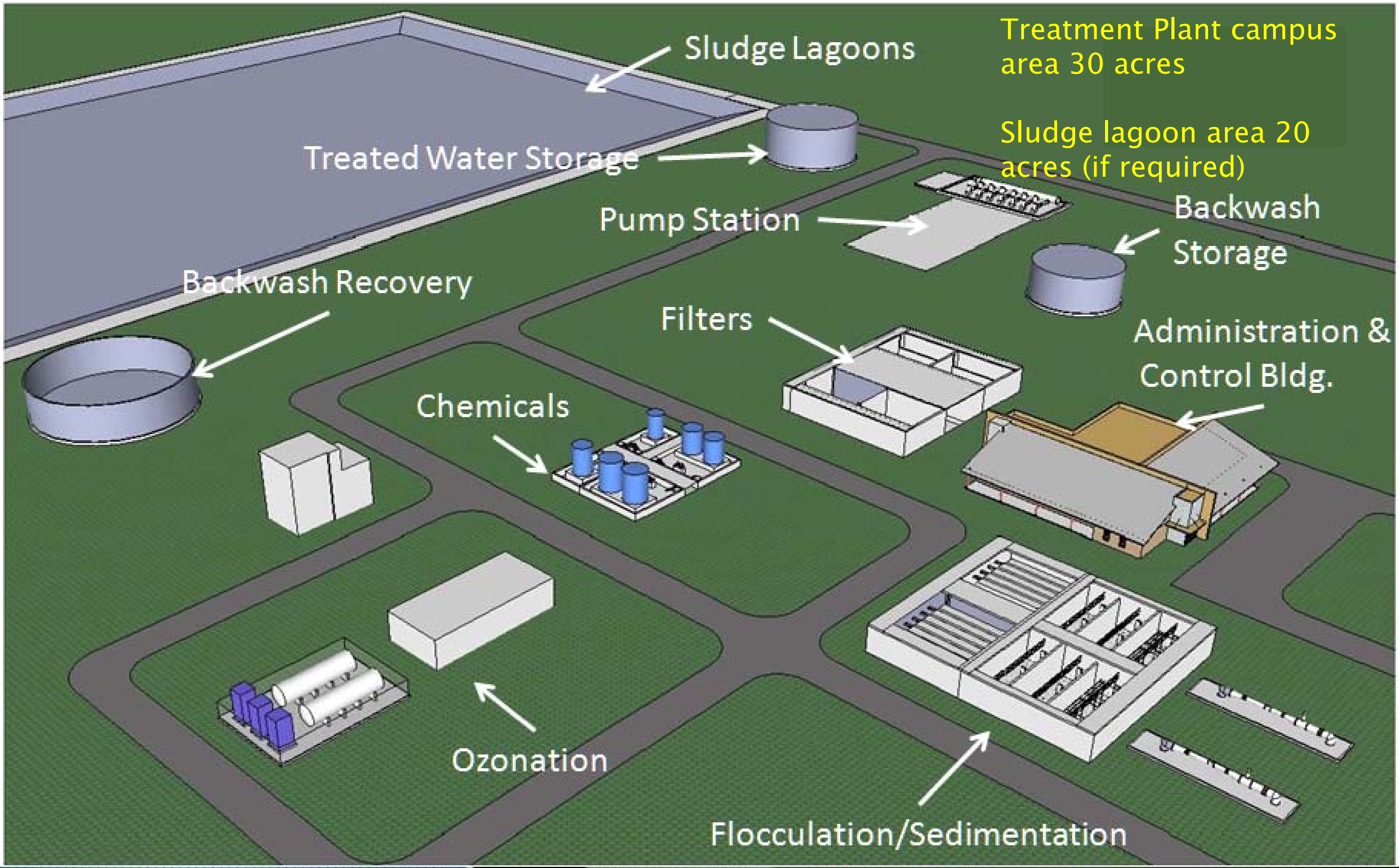
- Estimate of probable total cost for each site
- Deliverables
  - Conceptual site plans for new facilities
  - Conceptual process design for WTP
  - Conceptual water transmission system design (raw & treated)
  - Permit requirements for facilities
  - Cost projections for facilities

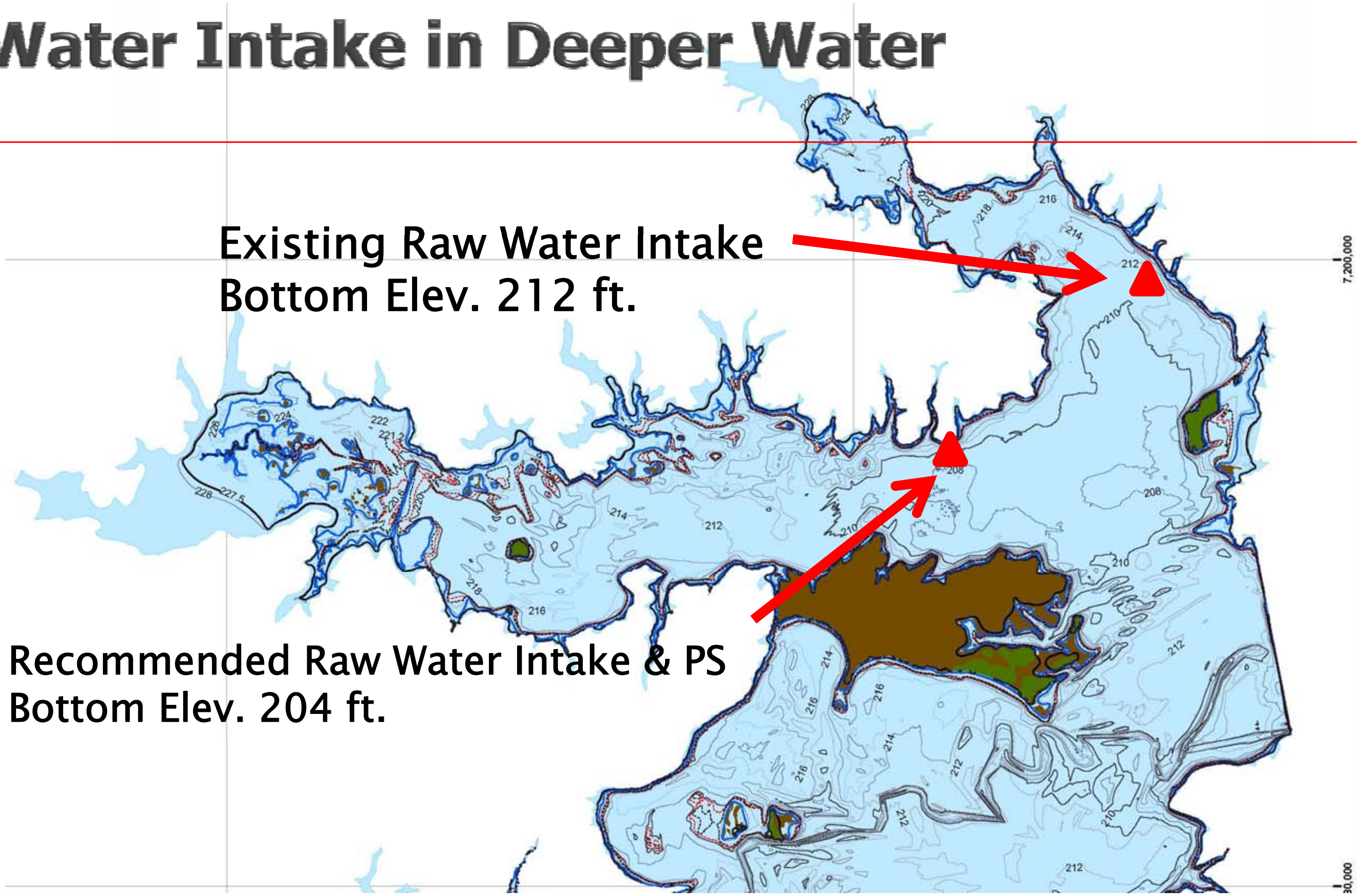
Peer Review of Phase 3 Study

- HDR Engineering provided peer review of the Phase 3 Study.
- Findings:
  - No major technical issues with work completed by CH2MHILL
  - Certain project goals impacted project costs
    - Rigorous taste & odor control
    - More reliable raw water system
  - Differences between HDR conclusions and CH2MHILL conclusions are the result of differences in the respective scopes of work
    - CH2MHILL was asked to evaluate a long term water supply system for the member cities
    - HDR was asked to evaluate prolonging the life of the New Boston Road WTP



Treatment Plant campus area 30 acres
Sludge lagoon area 20 acres (if required)
Sludge Lagoons
Treated Water Storage
Pump Station
Backwash Storage
Backwash Recovery
Filters
Administration & Control Bldg.
Chemicals
Ozonation
Flocculation/Sedimentation

Recommendation: Construct New Raw Water Intake in Deeper Water



Advantages of New Raw Water Intake Site

- Near shore water depth is sufficient to assure reliable water supply from the entire conservation pool (Elev. 215.5 ft.).

- The new pump station and intake can be designed to reliably draw water from the entire conservation pool

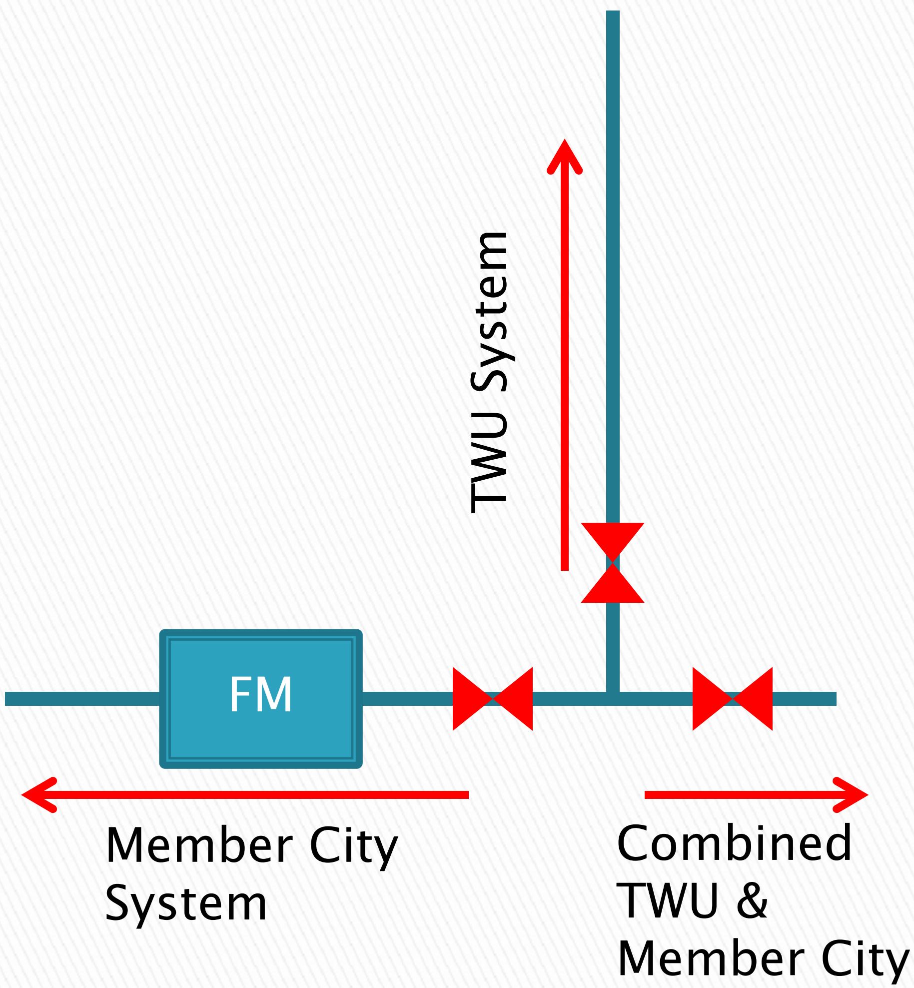
- The raw water system can be designed for an initial phase capacity of 20 MGD and to accommodate the ultimate system capacity of 60 MGD.

- The new site is less susceptible to sedimentation than the existing site.

Recommendation: Isolate (to the extent possible) the Member City System from the TWU System)

Advantages of Isolating Member City System

- System operates at most efficient pressure
- Water used by Member Cities more accurately measured
- Costs of system losses more fairly allocated



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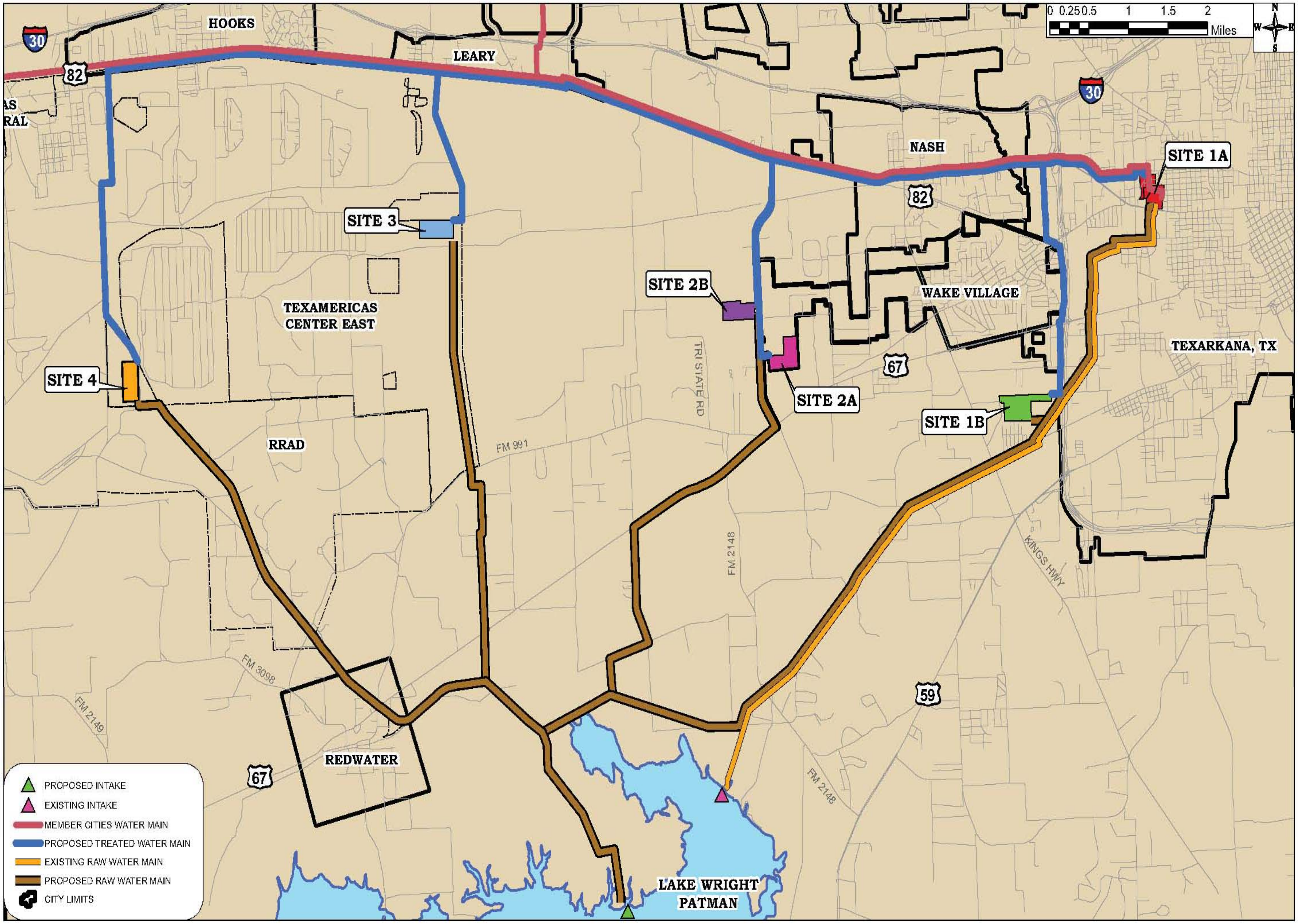

HOOKS
LEARY
30
82
NASH
SITE 1A
SITE 3
SITE 2B
WAKE VILLAGE
TEXAMERICAS CENTER EAST
TEXARKANA, TX
SITE 4
SITE 2A
67
SITE 1B
TRI STATE RD
RRAD
FM 991
FM 2148
KINGS HWY
FM 3098
FM 2149
59
REDWATER
FM 2148
LAKE WRIGHT PATMAN
0 0.25 0.5 1 1.5 2 Miles
PROPOSED INTAKE
EXISTING INTAKE
MEMBER CITIES WATER MAIN
PROPOSED TREATED WATER MAIN
EXISTING RAW WATER MAIN
PROPOSED RAW WATER MAIN
CITY LIMITS

Water Treatment Plant Site Evaluation Process

- Each site assigned a scored for every criteria
- Criteria assigned a weighting factor
  - A – Most important
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Evaluation Results

Water Treatment Process Selection

- From Phase 2 Studies:
  - Recommended Process:
    - Conventional Coagulation/Flocculation/Sedimentation (similar to New Boston Road)
    - with Ozone Disinfection (for taste & odor control)
    - and Biological Active Filters (for biological stability)
  - More favorable to process recommended to renovate New Boston Road Plant because:
    - Lower capital cost (conventional filters cost about 60% less than membrane filters)
    - Operation of conventional filters more familiar operators
    - Biological Actives Filters produces a more stable water than membrane filters (maintains disinfection residual)

Water Treatment Process Validation

- Recommended Process – Test Results
  - Treated water meets regulatory guidelines
  - Disinfection by-products not a problem
  - Taste & Odor issues addressed
  - Produced water stable (biologically and chemically …low corrosion potential)
  - Process assumptions (costs) from Phase 2 evaluations validated

Water Treatment Plant Site Selection

- Six sites objectively evaluated using methodology discussed previously:
  - Accessibility
  - Community Concerns
  - Construction Costs
  - Electric Power Availability
  - Environmental Impacts
  - Geotechnical Considerations
  - Operations Economics
  - Permit Requirements/Zoning
  - Topography
  - Area Requirements
  - Existing/Future Easements
  - Site Ownership

Water Treatment Plant Site Evaluation

Criteria	Weight Factor	Site 1A NB Rd	Site 1B	Site 2A	Site 2B	Site 3 TAC	Site 4
Accessibility	3	12	6	12	15	12	3
Community Concerns	3	3	6	12	9	15	15
Construction Costs	4	8	12	12	16	20	4
Electrical Power	3	12	12	12	12	12	12
Environmental Impacts	3	6	12	9	9	15	12
Geotechnical Concerns	2	10	10	10	10	10	10
Operating Expense	4	4	8	16	16	20	8
Permitting	1	3	4	4	5	4	4
Topography	2	8	8	6	4	6	6
Area Requirements	4	20	20	20	20	20	20
Easements	1	5	5	3	5	5	5
Site Ownership	1	1	5	5	5	5	5
Weighted Total Score		92	108	121	126	144	104

Community Concerns

- Located adjacent to a residential neighborhood
- In an existing commercial area
- Anticipated concern
  - Noise
  - Traffic
  - Visual Impacts
  - Neighborhood Impacts

- Located in TexAmericas Center
- Zoned for industrial commercial use
- Adjacent land use compatible

Site 1A
New Boston Road

Site 3

Construction Costs

- Increased costs
  - Need to purchase residential lots
  - Floodplain mitigation
  - Utility relocations
- Reduced costs
  - Sludge lagoons not needed

Site 1A
New Boston Road

- Increased costs
  - Need for sludge lagoons
- Reduced costs
  - Closest to new intake
  - Good topography

Site 3

Other Considerations

- Environmental Impacts
  - Floodplain
  - Noise
  - Visual
- Operating Expenses
  - Longer raw water pipeline increases pumping costs
- Site Ownership
  - Requires purchasing a number of residential lots

Site 1A
New Boston Road

- Environmental Impacts
  - Former Army Ammunition Plant
    - Site cleared from environmental issues
- Operating Expense
  - Shortest raw water pipeline reduces operating costs
- Site Ownership
  - Requires purchase of one tract from one willing seller

Site 3

Conclusion: Site 3 (TexAmericas Center on Bowie Parkway) Represents the Best Option For a Long Term Water Supply

Selected Site (Site 3): Costs

	20 MGD	25 MGD	35 MGD
Land & ROW	$500,000	$500,000	$500,000
Intake Facilities	$13,800,000	$14,000,000	$14,500,000
Raw Water Pipeline	$20,710,000	$20,710,000	$20,710,000
Treatment Plant	$51,900,000	$57,300,000	$68,700,000
Treated Water Pipelines	$6,400,000	$6,400,000	$6,400,000
Professional Services*	$9,280,000	$9,980,000	$11,080,000
Total	$102,590,000	$108,800,000	$121,890,000

* Exclusive of bond counsel, financial advisor, legal, etc.

Cost Comparison…Long Term Solution vs. Short Term Fix

Long Term Solution

- Land & ROW – $500,000
- Intake Facilities – $13,800,000
- Raw Water Pipeline – $20,710,000
- Treatment Plant – $51,900,000
- Treated Water Pipeline – $6,400,000
- Professional Services – $ 9,280,000
- Total – $102,590,000

* Long Term Costs are 2011 Basis

Short Term Fix

- Recommended Short Term Improvements to extend the life of the New Boston Road WTP– $28,339,000 *
  - Does not include professional fees
- Additional Items not Included in Short Term Improvements –$44,972,300
  - Taste & Odor Control System (UV/H2O2)– $14,022,300
  - Long Term Renovation (Replacement) of Raw Water Intake & Pump Station – $13,800,000
  - Long Term Renovation (Replacement of Raw Water Pipeline – $17,150,000
  - Long term replacement of High Service PS – $6,000,000
  - Treated water storage replacement (flood plane mitigation) – $4,000,000
  - Professional Services – $8,500,000
- **Total Cost for Longer Term Solution (Not Expandable) – $91,811,300**

* HDR Costs are 2008 Basis

Questions?

RWRD Public Meeting 5-22-12

City of NB

Paigi Alexander - Txk Gazette

Mike Brock - Local Atty.

David Turner NB City Council

Jackie Laney NB City Council

Jim Green - Mayor of WD

Michael Babb - Mayor of Hooks

Joe Dike - NB City Council

Johnny Branson - Mayor NB

Randy Mansfield - Leary Tx

Mark Maya - City of NB - City Mgr.

Wayne Smith Mayor Texarkana AR

Harold Bolt City Mgr. TXK.

Bill Cork - ED/CEO TexAmerica's Center

Bob Murray - MTG

David Williams - MTG

Bill King TWU

Ed Motley CH2M Hill

JAMES HANNA CANDIDATE COMMISSIONER PCT 3

Keith Tenney Davis Texarkana AR city council

ROBERT Gibson

Michael C West city of Hooks TX

Sherry & Elmore Potts Texarkana Ar.

Gary & Debra Campbell Texarkana TX

Wendell Davis Clarksville, Tx RRCWSC

Dennis Smith

R.M. Coston
Temple McKinnon TWDB
Brandy Channing Txk Gazette
Jerry Cochran Hooks
Luisa Rummels Hooks
Mary McQueen Tex AR
James Presley TX, TX
Greg Harmon New Boston City Council
Ginger Stripper Texarkana Water Util.
John Murphy TWU
[illegible] Avery
Michael Mija
BOB BRUGGEMAN CITY OF TXK, TX - Mayor
Adam Sacasa Texarkana Gazette
Ronny Looney New Boston Tex
Stuart McDonald TxK, TX
Richard Ellis City Council NB
Robin Aaron Citizen Tribune
Mandy Davis
Joel Davis Texarkana AR City Council ward 6
Ron Collins ~~Ron Coll~~ TCM
John Rooney Redwater

7:50 John Murphy - Avery Buy water from OAK GROVE, works @ TWU

1.) legal issues transfering water from TX to AR.
2.) No longer a flood plan
3.) Residuals not checked everyday

7:52 Wayne Smith

1.) Member Cities has full rights to LAKE Wright Patman
2.) pg 6 Separater RWRD from TWU
3.) undedicated S~~O~~ - for Raw water
4.)
5. HDR Peer Report - RIWWI

7:56 Ruth Penny Davis - AR City Council

7:59 1.) sees this as away to disolve TWU
2.) Purchase of land in Beverly -
3.) Consider about control - Equal partners now
Millwood water - easier treated. 2nd cleanest water,
4.) Hwy 71 plant could be used
50% sale.

8:00 Sherry Potts

8:01 1.) How is water split like between TX + AR

8:01 WAYN Smith -

1.) Not getting info. Going away not being able to make decision

8:01 David Turner - City of NB - council

① A.) T-made member city would be metered.
B.) Everyone is metered except for breaks.
C.) Should count total amount of water.
D.) Should be based on total.

② A.) Water production - not distribution
B.)

8:02 John Rooney - Former Redwater Mayor
8:07 1.) one variable volume distribution -
What are distribution requirements from the east + west of new plant.
2.) What are the water usage requirements of TX + AR.
3.) Neglect of maint of Existing Plant - can you comment on that.
4.) Condr

8:07 Mark Mayo.
1.) During layout of floodplain is that the lastest - 2000
2.) Even if NBRd Plant refurb its still a 20MGD
3.) Thank you RWRD for adding new member cities

3) We have a demand for more water than Whats avail

8:10
John Murphy - TWU
to MARK Mayo.
1.) If you found you Could build 2 plants for the price of one. Hwy 71 + TWU.
2.) 15MGD daily limit.
8:14 3.) TWU RAW water line leak - due to operator error.
4.) Where does info about leaks coming from. Came from study from HDR - commissioned by TWU.
5.

8:14 Bill Cork - TAC
8:22
1.) Study w/member cities Hwy 71 + TWU good ideal. Better cheaper fast
2.) TAC - not wanting to take over water. has contract w/City of TXK to buy water.
3.) transfer all water assets to City of TXK.
4.) TWU been involved
5.) as current water plant owner - I know the headache.
6.) 2009 - City TXK, TX, TWU - (way to make this future RAW supply. - not there happen. in 09, 06, 09
7.) BRAC - RRAD water quanity 0-25K acre feet of water. Score. RRAD Being looked @ again

8.) Potable / RAW Supply to Depot - water coming in from TAC helps keep depot open

9.) 22/11 - top 6 - 5 million day RAW water
Lost 1000 jobs

10.) opportunity are passing up by. - loosing jobs -

11.) 1969 $ 20 million
2012 $ 125 million

12.)

8:22 Clyde Siebman

8:24 1.) Engineer's tried to take 1st step - this is not the final step - We need Ark.
2.) How to figure how to deliver best water, best price
3.) Conflict of personalities
4.) figure out how to get from here to there

8:25 GARY Campbell

8:26 1.) TXK, TX taxpayer paying for this - are member cities going to paying taxes. Regional tax Base?

8:26pm Josh Davis - Ward 6

8:26pm 1.) agrees wheres money coming fund
2) needs more info before he can get onboard

question from John murphy to Josh Davis → If RWRD controls this what say do you have
Each member city take on a Bond.

8:29 Clyde Siebman - this is technical presentation.
fund yet to be decided.
thinks All member being responsible financially.
TAX Base, Rev Bonds. - Join arms Regionally

Michael Westin
8:32 Phase 1 -
financial Phase started yet?

8:33 Ed Motley C2H2Hill
He understand that Water already mix
State laws

Wayne Smith Says there is

8:34 Bill King

8:37 1) There are no fees that are lost.
T4K,Tx has paid for the 1st 5 million gallons
due in 2016 and will be paid.
2) no problems that he is aware of 50 yr old structure
19.6 mil in last 12 mo. 18 best w/ current plant
3) condition

8:38 Dennis Smith

8:46 1.) Study is flawed, we ARE joined and can not
be separating us - If ark wants to get our
attention they will just cut off water water
on Sanderson Ln.

2.) He hopes C2HM Hill or HDR weren't the
original Engineers of original plant.
line the creek - fill w/dirt.

Millwood plant built in 84

filter issue - couldn't be improved or
isolated - no true
Could be lined.
He thinks that this study is bias.
Elevate structures instead of buying land
in Beverly.
Thinks this study has holes - we haven't
consider Millwood.

8:46 Sherry Potts:

1) Why are there not any AR members on RWRD

8:47 Bill Cork

8:51 Be careful how we char. relationship
RWRD has a memo agreement w/ARK.
TWU - relationship between TX & AR.
Create frame work to come together.
Expand membership. ~~Its~~ A new day.
We have an excellant opportunity since
1969.

8:51 Dennis Smith - we use TWU water connected
by pipe line

8:52 Clyde - RWRD never will be a water
distrubutor. Not a competor of TWU.

TAC website
T&K gaz.
cit tribune

~~How d~~ Where do we go from here?
Do what Bill suggested - we want AR involved.
Legislation was crafted to contract
with other States.

8:56 John Rooney - ATCOG (federal) (Bobby Ferguson) there has
been a council of govt - Not a state agency
contractual arrangement - instead of votes.

wk from
Wed. May 30th

Comments will be taken until COB May 30th
@ MTG

Attachment I
Riverbend Water Resources District
Regional Water Facility Planning Study
TWDB Contract No. 104831075 Draft Report Review Comments

General:

1. Please print the final report double-sided as required by the contract.
2. Please summarize the public meetings held for this project and any public comments received in the final report. Sign-in sheets from the meetings may be included.

Executive Summary:

3. Please list the members or customers of the district that potentially will be served by any new regional facilities in the executive summary or in chapter one of the report.
4. Figure ES-02 and Figure 5-01: There are both stars and green dots indicating intake locations. Please provide more detail in the map legend differentiating these locations to prevent confusion.
5. Figure ES-03 & Figure 6-01: The pipeline infrastructure required for each alternative is not differentiated. Suggest coding pipeline routes for each alternative to prevent confusion.
6. Since this is the third phase of a 3-phase study, please summarize the first two phases in the executive summary or reference the location in the main report of this discussion.

Section 4:

7. SOW Task 1.D – Please clarify if the raw water samples collected for analysis were dry weather and wet weather samples in the final report.
8. SOW Task 2.F – Please include the results of the monthly raw water sampling in the final report.

Section 5:

9. In Section 5, page 50, paragraph 2, please define NVGD in the final report.
10. In Section 5, page 50, paragraph 3, it states that the reservoir level dropped below 220 feet 15 times during the simulation period, but the last sentence states that the reservoir dropped below 220 feet 27 times during the simulation period. Please clarify or reconcile the numbers in the final report.
11. SOW Task 3.B – Please include the initial hydraulic calculation and recommendations for preliminary size for the new raw water transmission pipeline in the final report.

Comments for Consideration:

1. Suggest identifying member entities of the Riverbend Water Resources District and participants of the study. Suggest including a map showing the system location for each of these entities. For example, FM2253 is mentioned several times in the report, however no map was provided to provide a reference for this location.
2. Suggest adding footnote with reference citation for previous studies, including HDR study the first time they are mentioned in the report (Executive Summary and Introduction) and each time thereafter.
3. The report states that RWRD was created in 2009; however the member system was constructed in the 1960s. Suggest describing the system history in more detail to explain the date discrepancy.
4. Suggest adding subsection numbers to subtitles to aid the reader in navigating the report.
5. Figure 2-03: Suggest adding North arrow and scale to map figure.
6. Section 3: Suggest adding a table with anticipated Federal and State drinking water standards and anticipated treatment goals for constituents of interest.
7. Please include a discussion of potential sources of financing for the recommended alternatives, including TWDB financial assistance programs. Information on TWDB programs is available at http://www.twdb.texas.gov/financial/programs/