7th Semi-Annual Report to EPA

Sparta Aquifer Recovery Study

Union County, Arkansas

August 2005 – February 2006

U.S. EPA Grant X-976090-01-0

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Burns & McDonnell
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UNION COUNTY
WATER CONSERVATION BOARD

7th SEMI-ANNUAL REPORT

SPARTA AQUIFER RECOVERY STUDY

August 2005 – February 2006

U.S. EPA Grant X-976090-01-0

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Union County Water Conservation Board
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1.0 INTRODUCTION

The Union County Water Conservation Board (Board) is conducting the Sparta Aquifer Recovery Study (Study) for the purpose of monitoring water levels and water quality in the aquifer as three area industries formerly using groundwater from the Sparta aquifer convert their raw water source to the Ouachita River. The study area includes all of Union County, Arkansas and parts of adjacent counties in Arkansas and Louisiana. Funding for the study is provided by a $997,800 grant from the U.S. Environmental Protection Agency (EPA) with matching funds by the Board in the amount of $52,516. Burns & McDonnell Engineering Co. (B&McD) is managing the Study for the Board, with partnership by the U.S. Geological Survey (USGS) and the Union County Conservation District (UCCD).

1.1 BACKGROUND

The Sparta aquifer is an important source of groundwater for northern Louisiana and southeastern Arkansas. The major pumping centers are located in Hodge and Monroe, Louisiana; and El Dorado and Magnolia, Arkansas. The Sparta aquifer in Union County, Arkansas is a confined aquifer consisting of a sequence of unconsolidated sand units that are contained within the Sparta Sand formation (Hays, 2000).

Previous studies concluded that the rate of withdrawal in some areas exceeded the aquifer recharge rate causing rapid water level declines. Consequently, a large cone of depression developed in the Sparta aquifer under Jefferson County and the south-central region of Arkansas including Union County, and beneath the north-central portion of Louisiana in the vicinity of Monroe.

Figure 1-1 illustrates groundwater potentiometric contours based on 2001 water level data. An observation well hydrograph presented in Figure 1-2 shows the effect of groundwater pumping, at high rates of withdrawal in excess of recharge from the Sparta aquifer over the past 60 years. The hydrograph indicates that groundwater levels measured at Monsanto Industries in El Dorado declined nearly 255 feet between 1942 and 2001, representing an average decline of over 4 feet per year. Water levels in pumping centers in north central Louisiana have shown similar declines. Recent data from the Monsanto well show that the aquifer levels have begun to recover, with groundwater rising to levels not observed since the late 1980s.

Additionally, in some areas the overdraft is causing upwelling (upward movement of water from underlying aquifers), and lateral migration of high-salinity water. Specific conductance (a physical

Figure 1-1. Potentiometric surface in Sparta aquifer, Spring

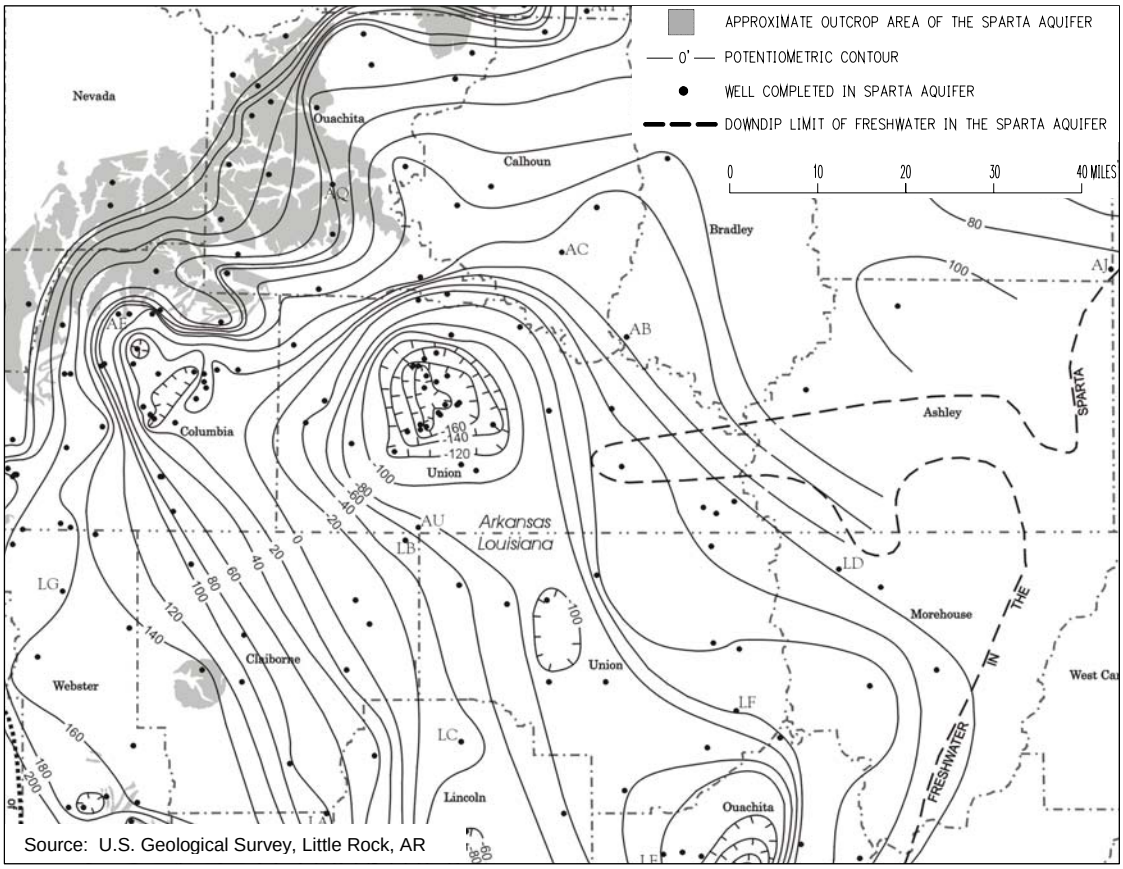
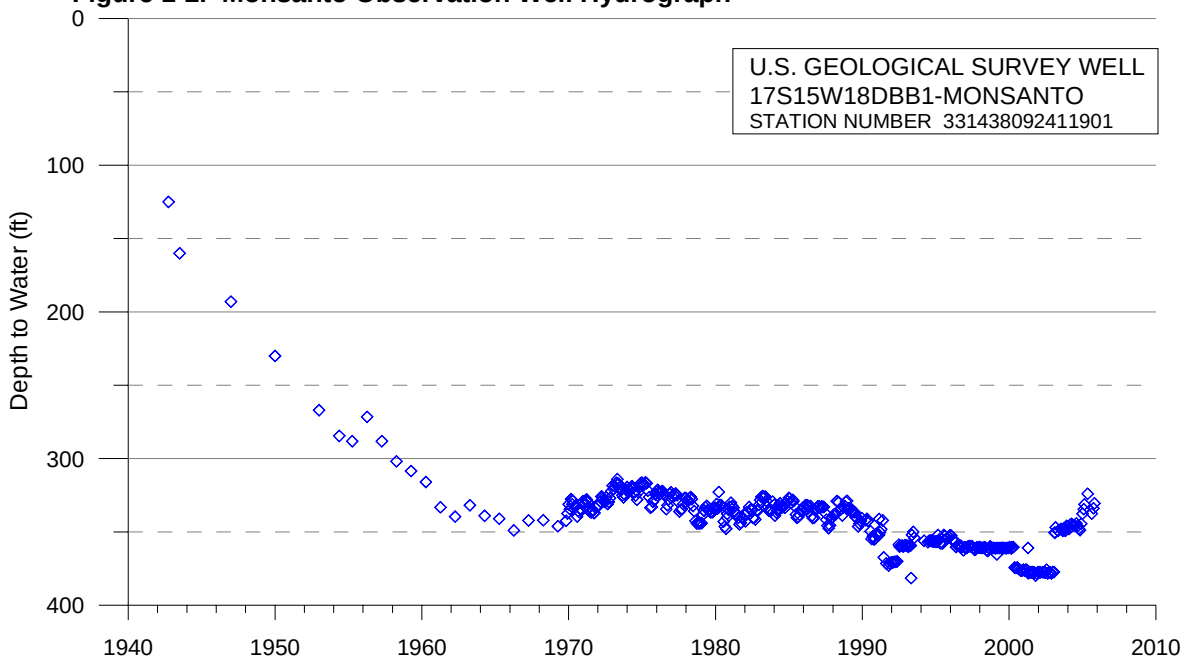


Figure 1-2. Monsanto Observation Well Hydrograph



Data from U.S. Geological Survey, 2005

parameter directly related to the amount of dissolved minerals in solution) is fairly low in Jefferson County, but increases to the northeast and gradually to the south toward the Louisiana state line, with higher specific conductance values potentially corresponding to the cones of depression in Union and Columbia Counties. Specific conductance values greater than 2000 microSiemens per centimeter (μS/cm) for groundwater from the Sparta aquifer have been documented in Union County (Joseph, 2000), compared to a range of about 200 to 1200 μS/cm in wells currently being studied.

In 1996, the Arkansas Natural Resources Commission (then the Arkansas Soil and Water Conservation Commission) designated the area including the counties of Bradley, Calhoun, Columbia, Ouachita, and Union as the State's first Critical Groundwater Area. In 1999, the Union County Water Conservation Board was formed to manage the Sparta aquifer. One of its first tasks was to develop a Water System Master Plan to explore alternatives to conserve the Sparta aquifer. The Board developed the Ouachita River Water Supply Project, a conservation project that would provide water from the Ouachita River as an alternative to groundwater for selected industrial users, reducing withdrawals from the Sparta aquifer by an average of nearly 9 million gallons per day. Appendix A contains a description of the Project.

Phases 1 and 2 of the project are now complete. Phase 1 consists of a 65-million gallon per day (MGD) intake on the Ouachita River, a water treatment facility, and pipeline to the Union Power Station. Phase 2 consists of a pump station, a 3-million gallon storage tank, and additional pipeline with service connections to three area industries. As of October 2005, the participating industries – Lion Oil, Chemtura (formerly Great Lakes Chemical), and El Dorado Chemical – are all utilizing water from the Ouachita River.

1.2 PURPOSE OF STUDY

Timely monitoring of water levels and water quality in the aquifer is critical to evaluating the success of this conservation project and determining the need for future improvements. This Study will provide the Board with data to evaluate the success of Phases 1 and 2 of the Water Supply Project, and to determine if Phase 3, consisting of additional industries being connected to the pipeline, is required.

To accomplish these activities, water level and water quality monitoring networks have been established in southern Arkansas and northern Louisiana. These are described below, and summarized in Appendix B, which contains a comprehensive map of the networks.

1.3 SUMMARY OF STUDY ACTIVITIES

Major Study activities that have occurred since August 2005 include automated and manual water level monitoring, water quality sampling, and web site maintenance.

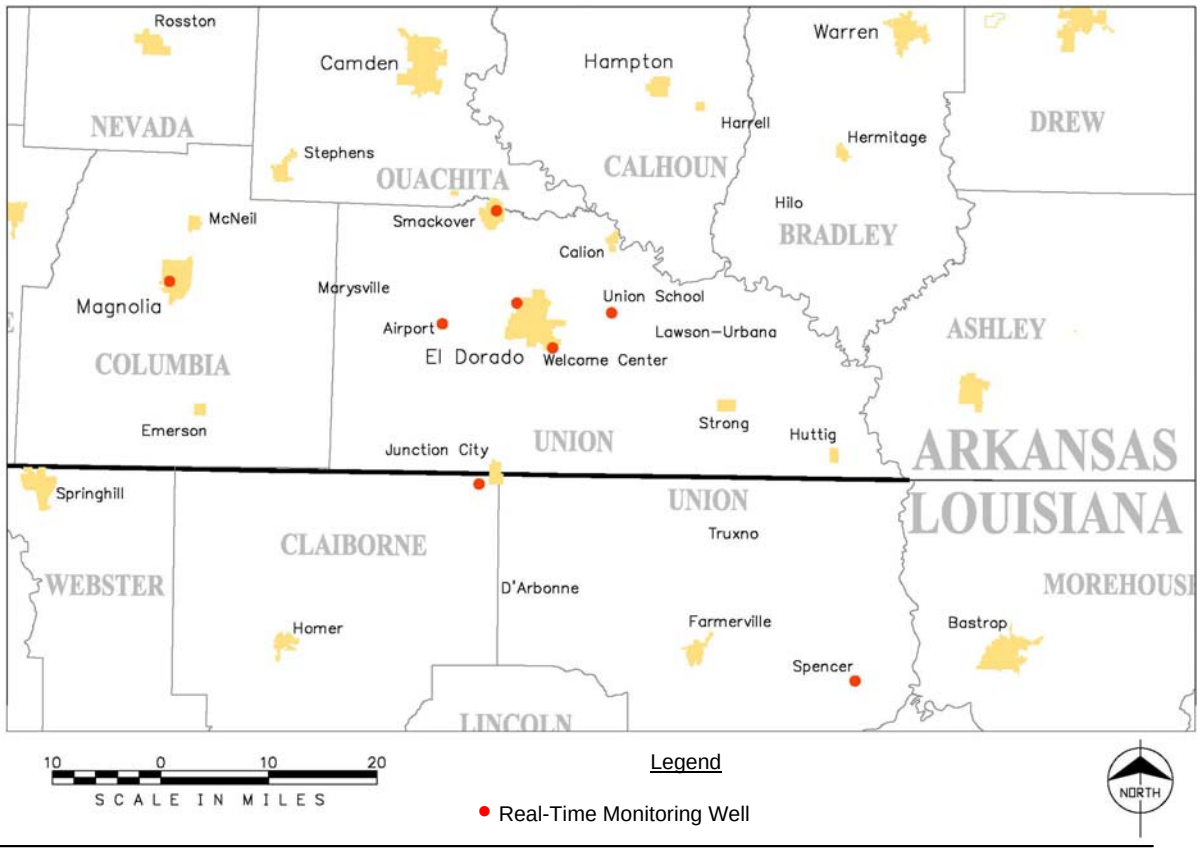
1.3.1 Groundwater Level Monitoring

Three water level monitoring networks exist: a real-time network maintained by the USGS; an automated data logger (ADL) network maintained by UCCD, and a manual network also maintained by UCCD. Appendix B shows the location of the real-time and ADL monitoring wells. Also shown in Appendix B are the locations of the water quality monitoring wells. All water level data can be accessed via the Study web site.

1.3.1.1 Real-Time Wells

Groundwater levels are measured and recorded hourly in the eight real-time water level monitoring wells, shown in Figure 1-3. These wells are used to monitor water levels closest to the center of the cone of depression in the Sparta aquifer. A central computer at the USGS communicates with each data logger

Figure 1-3. Real-Time Sites



via cellular telephone modem and automatically retrieves data from the entire real-time network four times daily. This data is available on the Internet at USGS' National Water Information System (NWIS) web site (http://waterdata.usgs.gov/ar/nwis/ current/?type=gw) or via links on the Study web site (www.ucwcb.org). Section 1.3.3 contains instructions for accessing USGS water level data for the Study. Hydrographs that show water levels in the real-time wells are presented in Section 2.0.

Table 1-1 provides additional information about the real-time water level monitoring wells.

Table 1-1
Real-Time Well Information

Well Location	USGS Well ID	Total Depth	Sparta Unit
Airport	17S17W25DBA2	648	El Dorado Sand
Magnolia	17S21W11DCC2	428	El Dorado Sand
Monsanto Chemical	17S15W18DBB1-MONSANTO	540	El Dorado Sand
Smackover, AR	16S16W02ABC1	552	El Dorado Sand
Union School[1]	17S14W22BAB1	607	El Dorado Sand
Welcome Center[1]	18S15W03DAB1	807	El Dorado Sand
Junction City, LA	CL-149	736	El Dorado Sand
Spencer, LA	UN-26	745	El Dorado Sand

[1] New monitoring well drilled specifically for this network.

1.3.1.2 Automated Data Logger (ADL) Wells

The automated data logger (ADL) network consists of eight wells at locations shown in Figure 1-4. Six of the wells were selected from the large group of wells evaluated and subsequently eliminated by USGS as potential real-time monitoring sites. The other two ADL wells (at Hilo and at Strong) were drilled specifically for inclusion in the network.

Water levels are measured and recorded once daily in these wells, and the data loggers are downloaded monthly by UCCD staff. These wells form a supplemental water level monitoring network that as a group surround the real-time wells. Hydrographs that show water levels in the ADL wells are presented in Section 2.0.

Figure 1-4. Automated Data Logger Sites

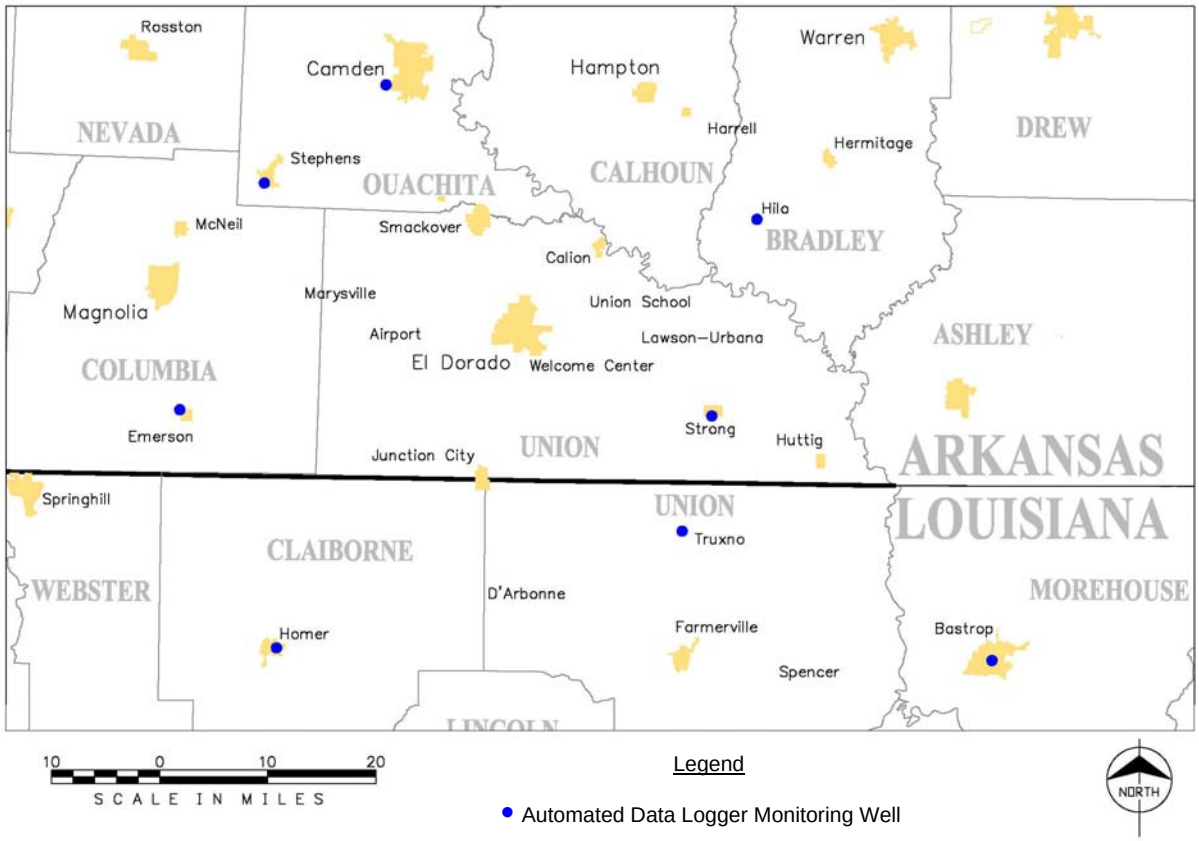


Table 1-2 provides additional information about the ADL water level monitoring wells.

Table 1-2
Automated Data Logger Well Information

Well Location	USGS Well ID	Total Depth	Sparta Unit
Hilo, AR	NA[1]	800	El Dorado Sand
Camden, AR	14S17W05CAD1	223	El Dorado Sand
Stephens, AR	15S19W21CDD2	300	El Dorado Sand
Emerson, AR	19S20WDAD1	451	Greensand[2]
Strong, AR	NA[1]	736	El Dorado Sand
Homer, LA	CL-58	482	El Dorado Sand
Bastrop, LA	MO-5	860	El Dorado Sand
Truxno, LA	UN-84	696	El Dorado Sand

[1] NA – Awaiting assignment of USGS Well ID. Monitoring well is owned by the Board.
[2] The Greensand is a water-bearing unit of the Sparta Fm. situated above the El Dorado Sand.

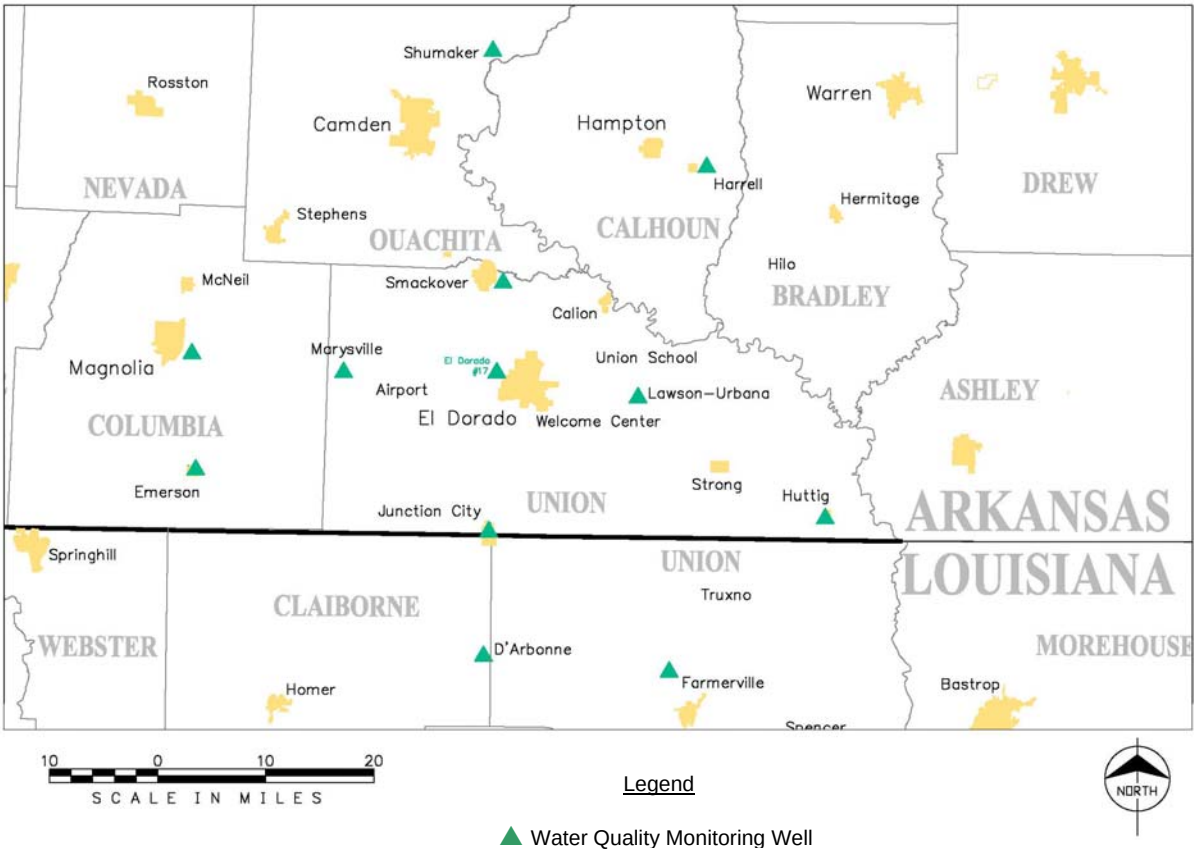
1.3.1.3 Other Monitoring Wells

Additionally, water level data from over 250 wells dispersed throughout the five-county Critical Groundwater Area of southern Arkansas that are part of the Sparta Aquifer Validation Project being conducted by the UCCD are included in the Study. The remaining wells continue to be measured manually three to four times per year. All data is uploaded to the Study web site after it is collected and processed.

1.3.2 Groundwater Quality Monitoring

A network of 12 water quality monitoring wells has been established. These wells, shown in Figure 1-5, are production wells belonging to local industries and municipalities. Samples are collected twice annually by USGS from each of the 12 water quality monitoring wells. To date, seven sampling rounds have been conducted. Part 2.1 of this report discusses water quality monitoring activities and results since the start of the project.

Figure 1-5. Water Quality Sampling Sites



1.3.3 Project Web Site

A project web site has been active since May 2003. The site contains program information describing the Study, and provides direct access to water level and water use data from wells in the project area. Ongoing work to maintain and improve the web site is described in Part 2.3. The Institute for Economic Advancement (IEA) at the University of Arkansas-Little Rock hosts and maintains the web site for the Board. Data updates are sent periodically (usually monthly) from UCCD to IEA to be uploaded.

Procedures to access data on the website are described below.

To see the locations of USGS real-time wells and to access groundwater levels measured in those wells as part of the Study, use the following procedure:

- Navigate to the website at www.ucwcb.org.
- Click on the Interactive Map link on the left side of the page.
- When the map window appears, zoom in on the area of interest.
- On the Legend, make the "USGS Real-Time Wells" layer *visible* and *active* by checking the appropriate boxes. (NOTE: Only one layer can be active, but several layers can be visible at a given time.)
- Click on "Refresh Map". The real-time well icons will appear on the map.
- Click on the  symbol on the left side of the page.
- Select the icon on the map for the USGS real-time well that is to be reviewed.

This procedure will take the user directly to the USGS web page for the selected well. Please also note that a table listing these wells with links directly to their data can be accessed from USGS' NWIS website at http://waterdata.usgs.gov/ar/nwis/ current/?type=gw.

To see the locations of the ADL and manually measured monitoring wells and to access groundwater levels measured in those wells as part of the Study, use the following procedure:

- Navigate to the website at www.ucwcb.org.
- Click on the Interactive Map link on the left side of the page.
- When the map window appears, zoom in on the area of interest.

- On the Legend, make the "Automated Data Logger Wells" or the "UCCD Monitoring Wells" layers *visible* and *active* by checking the appropriate boxes. (NOTE: Only one layer can be active, but several layers can be visible at a given time.)
- Click on "Refresh Map". The appropriate well icons will appear on the map.
- Click on the  symbol on the left side of the page.
- Select the icon on the map for the ADL or manually measured well that is to be reviewed.

This procedure will open a new window displaying a graph and table of measured water levels for the selected wells.

* * * * *

2.0 RECENT ACTIVITIES

2.1 GROUNDWATER LEVEL MONITORING

This section describes water level monitoring efforts for the Study. Eight real-time sites have been active since late summer of 2003. Additionally, eight wells including two new monitoring wells were identified for deployment of ADLs by UCCD. The ADL wells were activated over a period of several months from March to December 2004. With the exception of the well at Emerson, which developed a leak in the casing resulting in a damaged data logger, all have been continuously collecting groundwater levels since activation. The Emerson well is currently being evaluated to determine if it can be repaired, or if a replacement well will be required. Routine, manual water level measurements by UCCD for the Sparta Aquifer Validation Project continue as well.

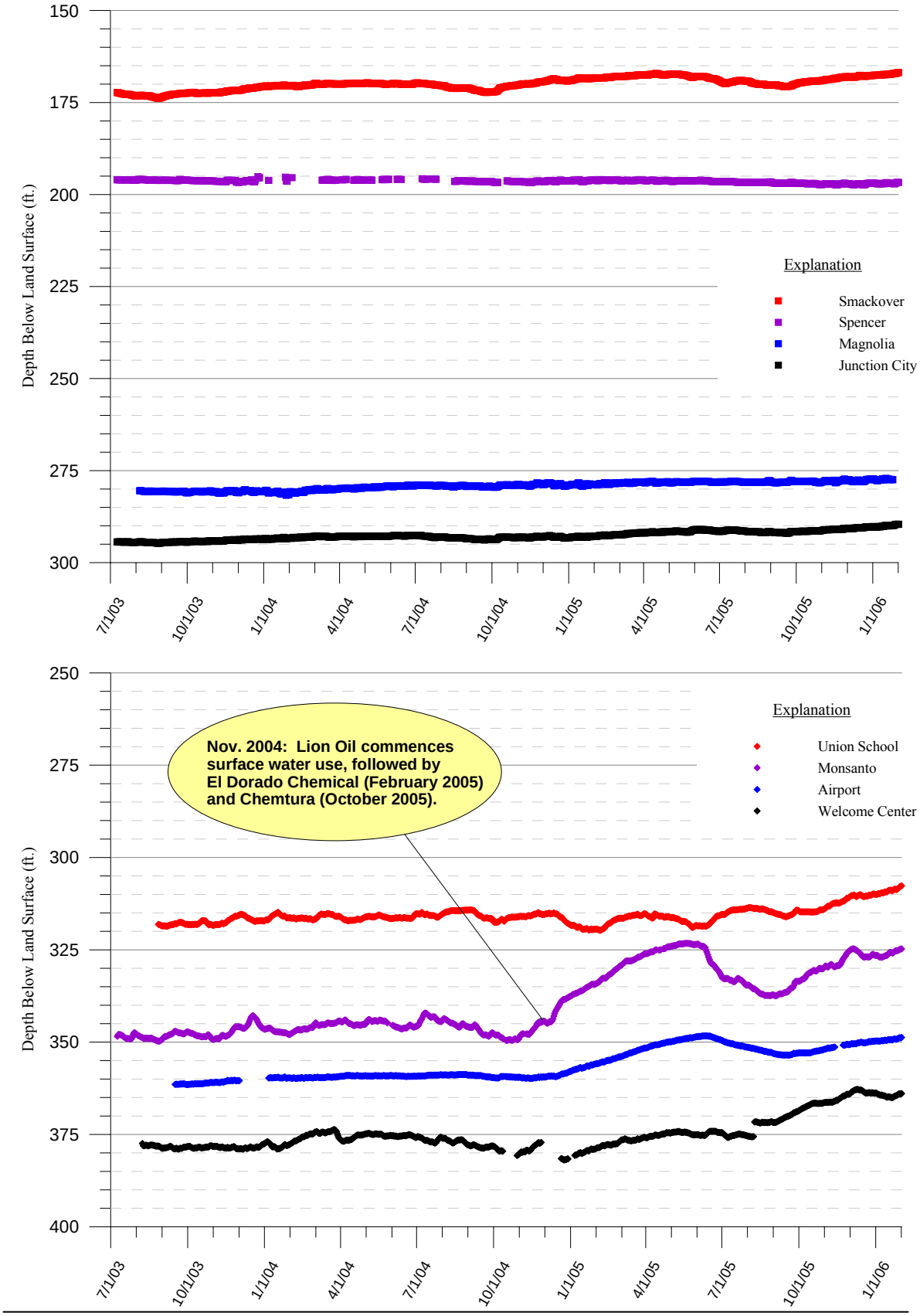
2.1.1 Real-Time Monitoring Sites

The real-time monitoring sites maintained by USGS are equipped with real-time water-level monitoring equipment allowing water level data to be updated four times daily. Figure 2-1 shows daily water levels since installation of the data loggers.

The graphs indicate an overall upward trend in water levels at nearly every site, with only Spencer (Louisiana) exhibiting a flat to very slight downward trend. The monitoring sites closest to the industries that have converted their raw water source from groundwater to surface water exhibit the most pronounced effects, experiencing significant recoveries beginning in late November 2004. The July-to-September 2005 declines in water levels at the Airport and the Monsanto monitoring wells reflect a typical summer decline, although much greater than the relatively short record of water level data shown by these hydrographs. This recent anomaly is likely a result of greater local demand from the Sparta due to unusually hot, dry conditions that persisted during the summer months of 2005. The trends in most of the wells also show that water levels in several areas had already begun to gradually recover prior to the industries' switch to surface water, possibly as a result of conservation due to increased awareness of water level declines in the Sparta, both voluntary and as a result of imposition of groundwater conservation fees.

Data continues to be collected at these sites and transmitted to the USGS web site four times daily.

Figure 2-1. Real-Time Well Water Levels



2.1.2 Automated Data Logger (ADL) Water Level Monitoring Sites

The ADL network is a supplemental water level monitoring network consisting of eight wells, shown in Figure 2-3 that as a group surround the real-time network. Groundwater levels are measured daily and the data loggers are downloaded monthly at these sites. Hydrographs of the water levels measured in the ADL wells are shown in Figure 2-2

Water level trends for the most part are flat or slightly upward, with some exceptions. The Camden well has experienced an overall drop of about 5 feet since the start of the Study. Water levels in the Charles L. Lovett monitoring well at Strong have risen over 50 feet since monitoring commenced in September 2004. Although this rise may be due to re-distribution of municipal pumping in the area, a review of water use records suggests this is not the case. As a precautionary check for a potential problem with the integrity of the well casing, the feasibility of performing a downhole camera survey is being considered. The water level in the Bastrop (LA) monitoring well has recovered substantially over the past 4-5 months as well, possibly as a result of reduced or redistributed pumping in this area. Water use history for this area will be investigated for the next semi-annual report.

As noted and discussed in the previous semi-annual report, the casing in the Emerson well failed and it is currently not suitable for water level monitoring. An assessment of potential alternatives, which include repairing/treating the well or replacing it, is ongoing.

2.2 GROUNDWATER QUALITY MONITORING

The most recent round of sampling (the 7th sampling round of the Study) was performed by USGS personnel in January 2006 at the 12 water quality monitoring sites.

All groundwater samples were analyzed for chloride, temperature, and specific conductance. Temperature and specific conductance were measured in the field. All chloride analyses were performed by the National Water Quality Laboratory (NWQL) in Denver, Colorado. Procedures used to obtain and analyze the samples are described in the Quality Assurance Project Plan (QAPP), Revision 2 (B&McD, December 2004).

Figure 2-3 summarizes the analytical results for all rounds completed to date and provides a comparison with the Study's first four rounds of sampling and with historical data. Tabulated lab results for the 7^{h} round of groundwater sampling are contained in Appendix C.

Figure 2-2. ADL Well Water Levels

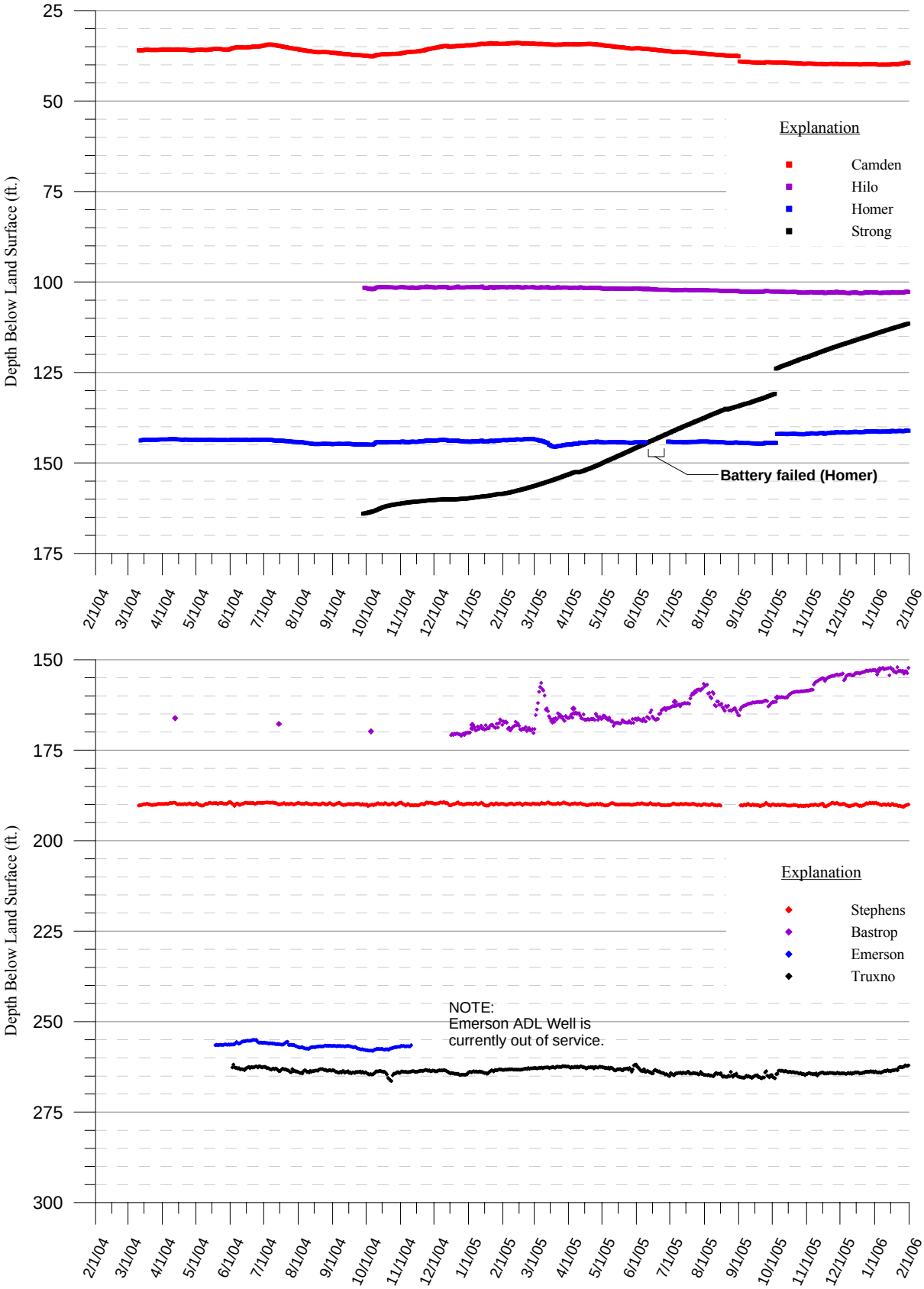


Figure 2-4

Based on chloride and specific conductance analyses during the first six rounds of sampling, there are no apparent significant changes in water quality in the wells being monitored. The anomalously low point on the Farmerville graph (July 2004) has not been repeated and the last several readings have been much closer to historical norms. Chloride levels in most of the sampled wells are well below the secondary maximum contaminant level (MCL) of 250 milligrams per liter, with the exception of the Farmerville and Huttig wells. Chloride levels in those wells are just below the MCL; the wells are in a downdip area of the Sparta where higher chloride levels typically occur.

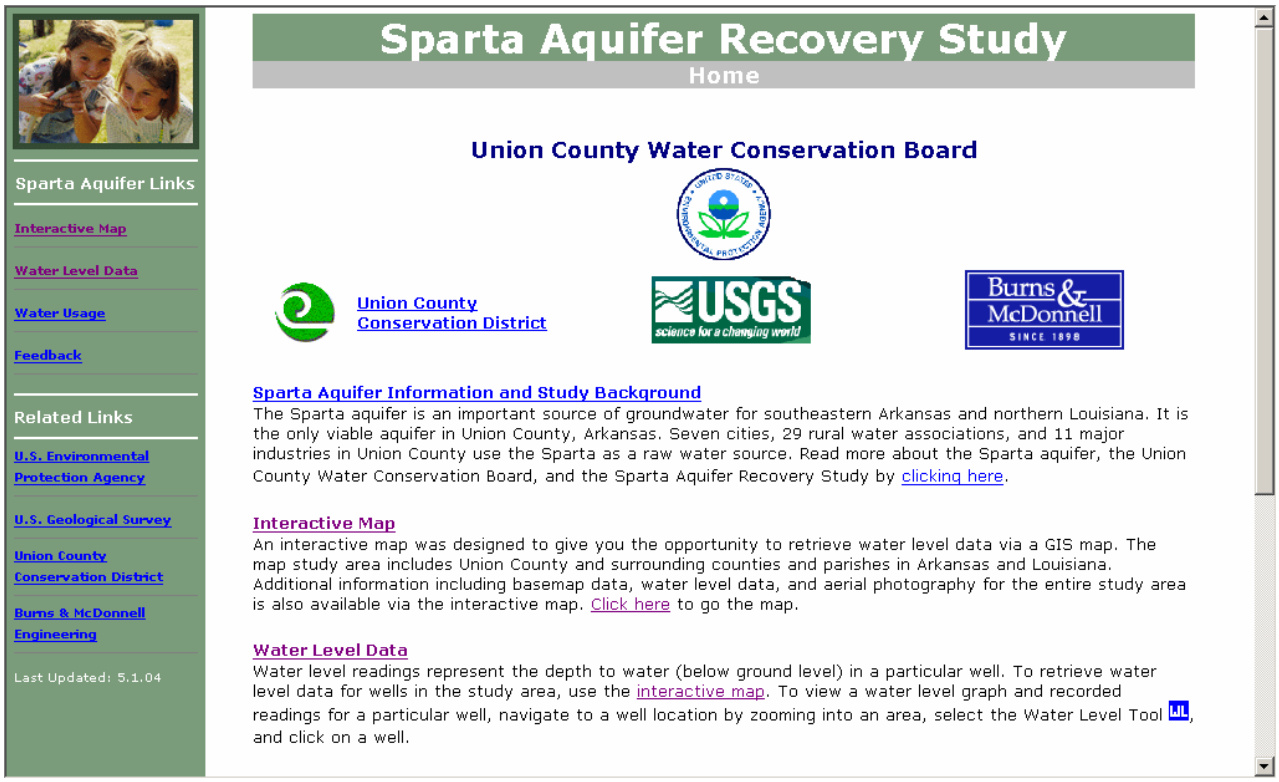
It is anticipated that as groundwater levels recover, chloride levels in some portions of the aquifer will stabilize due to increased hydrostatic heads in the Sparta. The increased head should minimize or prevent upward movement of water from higher-salinity zones underlying the Sparta, and lateral migration from poorer-quality areas of the Sparta. As chloride (and specific conductance) data are accumulated, they will continue to be analyzed to determine if such a trend is observed.

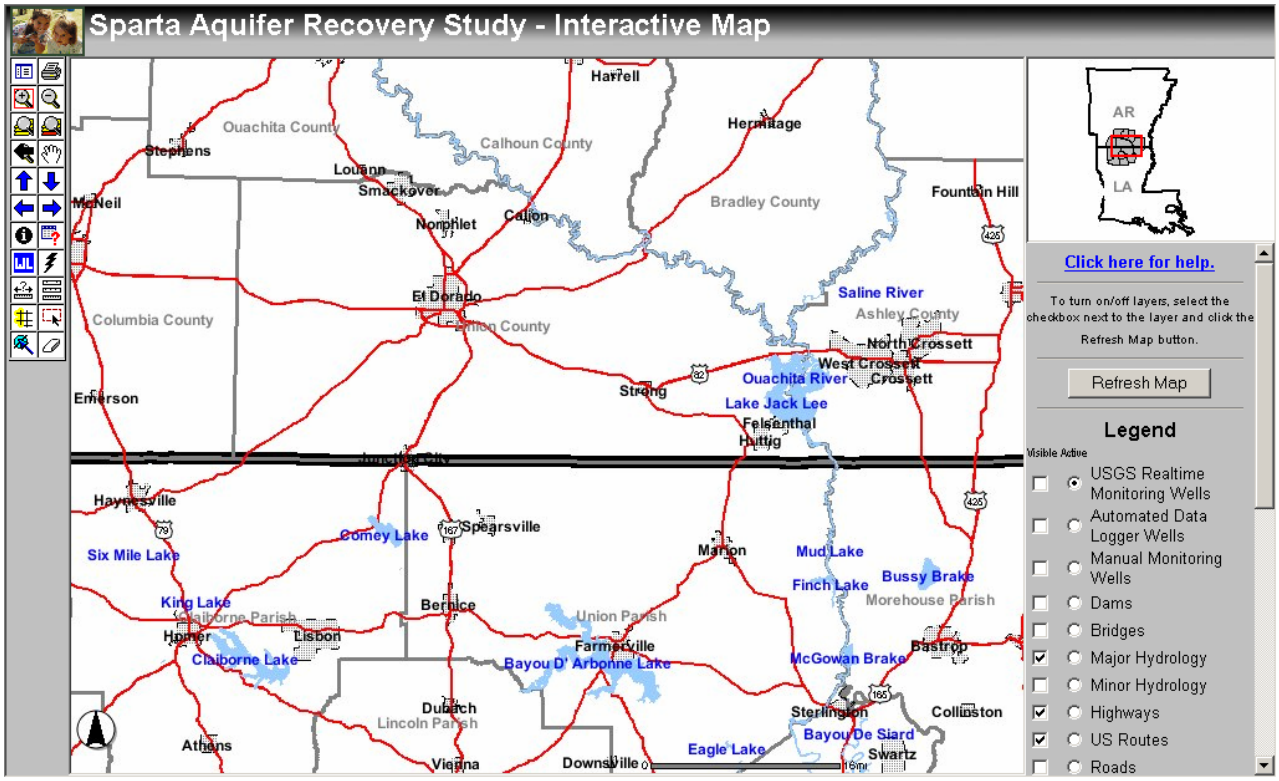
2.3 PROJECT WEB SITE

The Sparta Aquifer Recover Study web site has been active since May 1, 2003. The web site can be accessed at www.ucwcb.org.

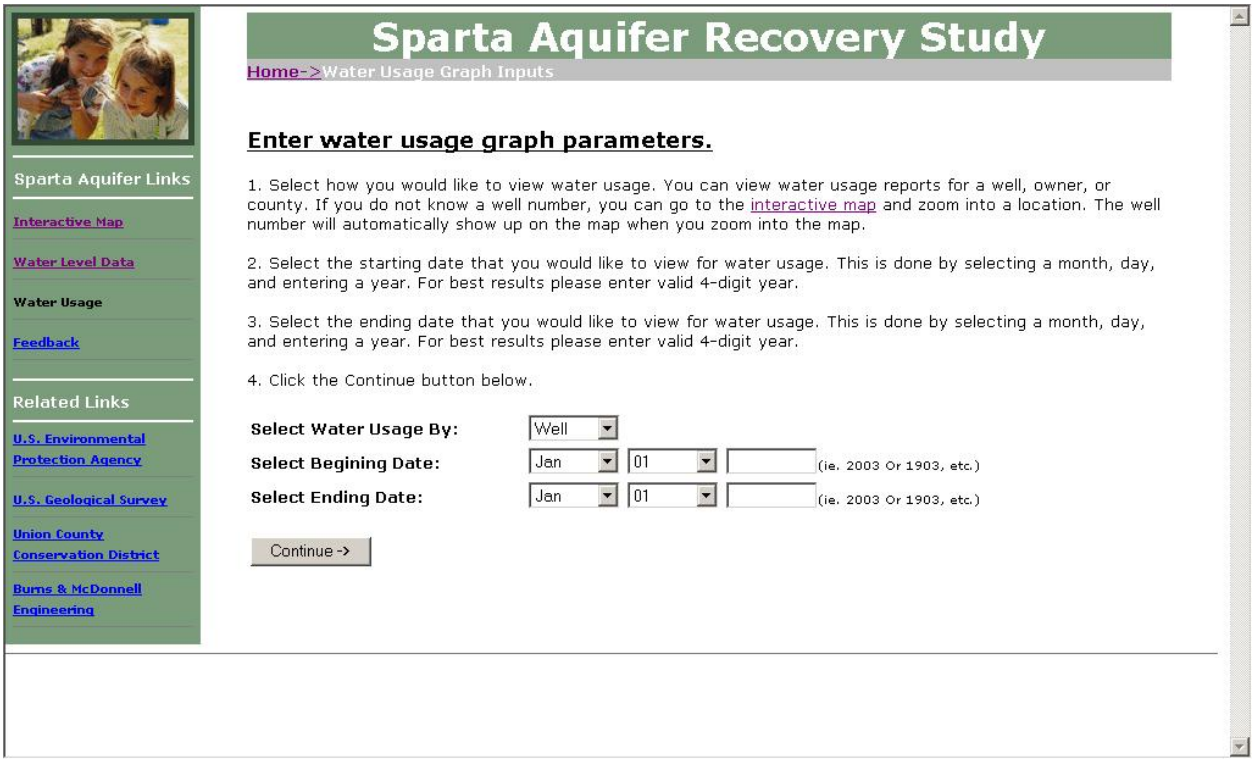
The web site is being continually updated. Web site activities for this reporting period consisted exclusively of data updates. No other activities were undertaken.

Shown on the following pages are images printed directly from the web site, displaying its various features. The first image is the welcome page with links to the various pages on the site and to the project partners' web sites. The second two images are from the interactive map page, including an image with the aerial photography layer turned on in the vicinity of the ADL well in Homer, LA. The final two images show the water usage page and an example of 2004 water usage for a registered water user.


Sparta Aquifer Recovery Study
Home
Sparta Aquifer Links
Interactive Map
Water Level Data
Water Usage
Feedback
Related Links
U.S. Environmental Protection Agency
U.S. Geological Survey
Union County Conservation District
Burns & McDonnell Engineering
Last Updated: 5.1.04
Union County Water Conservation Board
Union County Conservation District
USGS
science for a changing world
Burns & McDonnell
SINCE 1898
Sparta Aquifer Information and Study Background
The Sparta aquifer is an important source of groundwater for southeastern Arkansas and northern Louisiana. It is the only viable aquifer in Union County, Arkansas. Seven cities, 29 rural water associations, and 11 major industries in Union County use the Sparta as a raw water source. Read more about the Sparta aquifer, the Union County Water Conservation Board, and the Sparta Aquifer Recovery Study by clicking here.
Interactive Map
An interactive map was designed to give you the opportunity to retrieve water level data via a GIS map. The map study area includes Union County and surrounding counties and parishes in Arkansas and Louisiana. Additional information including basemap data, water level data, and aerial photography for the entire study area is also available via the interactive map. Click here to go the map.
Water Level Data
Water level readings represent the depth to water (below ground level) in a particular well. To retrieve water level data for wells in the study area, use the interactive map. To view a water level graph and recorded readings for a particular well, navigate to a well location by zooming into an area, select the Water Level Tool, and click on a well.


Sparta Aquifer Recovery Study - Interactive Map
Harrell
Hermitage
Ouachita County
Calhoun County
Stephens
Louann
Smackover
McNeil
Norphlet
Calion
Bradley County
Fountain Hill
El Dorado
Union County
Columbia County
Saline River
Ashley County
North Crossett
West Crossett
Crossett
Ouachita River
Strong
Lake Jack Lee
Felsenthal
Huttig
Emerson
Hampton
Hawesville
Spearsville
Comey Lake
Six Mile Lake
Marion
Mud Lake
Finch Lake
Bussy Brake
Morehouse Parish
King Lake
Claiborne Parish
Bernice
Union Parish
Homer
Lisbon
Farmerville
Claiborne Lake
Bayou D' Arbonne Lake
McGowan Brake
Bastrop
Dubach
Lincoln Parish
Sterlington
Collinston
Athens
Vienna
Downsville
Eagle Lake
Bayou De Siard
Swartz
AR
LA
Click here for help.
To turn on/off layers, select the checkbox next to the layer and click the Refresh Map button.
Refresh Map
Legend
Visible Active
USGS Realtime Monitoring Wells
Automated Data Logger Wells
Manual Monitoring Wells
Dams
Bridges
Major Hydrology
Minor Hydrology
Highways
US Routes
Roads


Sparta Aquifer Recovery Study - Interactive Map
AR
LA
Click here for help.
To turn on/off layers, select the checkbox next to the layer and click the Refresh Map button.
Refresh Map
Legend
Visible Active
USGS Realtime Monitoring Wells
Automated Data Logger Wells
UCCD Monitoring Wells
Dams
Bridges
Major Hydrology
Minor Hydrology
Highways
US Routes
Roads
Home

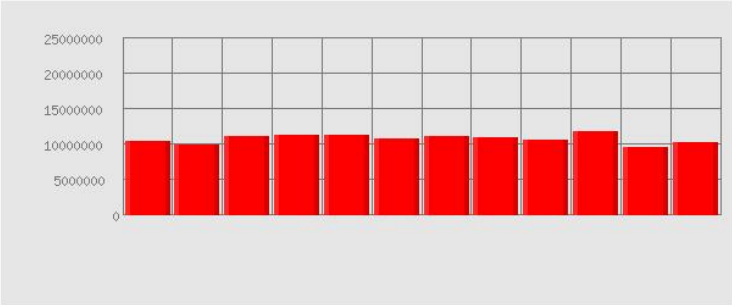

Sparta Aquifer Recovery Study
Home->Water Usage Graph Inputs
Sparta Aquifer Links
Interactive Map
Water Level Data
Water Usage
Feedback
Related Links
U.S. Environmental Protection Agency
U.S. Geological Survey
Union County Conservation District
Burns & McDonnell Engineering
Enter water usage graph parameters.
1. Select how you would like to view water usage. You can view water usage reports for a well, owner, or county. If you do not know a well number, you can go to the interactive map and zoom into a location. The well number will automatically show up on the map when you zoom into the map.
2. Select the starting date that you would like to view for water usage. This is done by selecting a month, day, and entering a year. For best results please enter valid 4-digit year.
3. Select the ending date that you would like to view for water usage. This is done by selecting a month, day, and entering a year. For best results please enter valid 4-digit year.
4. Click the Continue button below.
Select Water Usage By: Well
Select Begining Date: Jan 01 (ie. 2003 Or 1903, etc.)
Select Ending Date: Jan 01 (ie. 2003 Or 1903, etc.)
Continue ->

Sparta Aquifer Recovery Study

Home->Water Usage - Graph Inputs->Water Usage- Select->Query Results

Owner = El Dorado Chemical **From:** 01/01/2004 **To:** 01/01/2005

Average Monthly Water Usage: 10,592,683
Total Water Usage: 635,561,000



WELL	DATE	USAGE(GALLONS)
U1006	1/30/2004	530,000
U1010	1/30/2004	1,041,000
U1008	1/30/2004	5,241,000
U1009	1/30/2004	18,002,000
U1007	1/30/2004	26,477,000
U1006	2/28/2004	0
U1010	2/28/2004	0

3.0 FUTURE ACTIVITES

Activities planned during the next reporting period (August 2005 through February 2006) are described in this section. Appendix D contains a list of milestones and completion/anticipated completion dates.

3.1 GROUNDWATER LEVEL MONITORING

Groundwater levels will continue to be collected by automated processes and manually throughout the 5-year duration of the project.

Water-level measurements in the real-time wells will continue to be made hourly and automatically uploaded to the USGS web site every six hours. The data is placed in the USGS National Water Information System (NWIS) computer database and made available through the USGS Division of Water Resources, Ground-Water Data for Arkansas web site (http://waterdata.usgs.gov/ar/nwis/current/?type=gw), as well as via a link from unique well icons on the Study web site (www.ucwcb.org).

Water-level measurements in the ADL wells will continue to be made daily, and downloaded approximately every month by UCCD. The data will be processed and uploaded to the Study web site as it is collected, where it will continue to be available via the web site's interactive map.

Manual water level measurements will continue to be collected three to four times per year by UCCD. This data will be entered by UCCD after each round of measurements, transmitted to UALR-IEA and uploaded to the web site.

3.2 GROUNDWATER QUALITY MONITORING

The seventh round of groundwater sampling is planned for July 2006. It is anticipated that all 12 wells in the network will be sampled and analyzed by NWQL for chloride. Duplicate samples for quality control will be collected at two selected locations. Additionally, matrix spike and matrix spike duplicate samples will be collected and process as described in the QAPP. Field measurements of temperature and specific conductance will also be made.

Chloride data will continue to be tabulated, tracked, and compared with historic data to determine if changes in aquifer water quality are occurring. During the course of the study, analysis of other chemical parameters will also be performed if required for proper assessment of aquifer recovery. If it is

determined that additional analytes will be useful for purposes of the study, they will be incorporated and the QMP and QAPP will be revised.

After review by the USGS, water quality data will continue to be made available to users and interested parties on the Internet, stored in the NWIS database. USGS data specific to the Study can be retrieved via USGS' Water Resources of Arkansas web page at http://ar.water.usgs.gov/, where data from individual wells can be viewed and downloaded in tabular or graphic format. Historical data can also be downloaded or printed from the annual data reports available on this web page. Links from the Study web site will also direct the user to this data.

A summary of the data will be published in the USGS annual data report. Data will also be included in a USGS Fact Sheet summarizing the results.

3.3 PROJECT WEB SITE

Evaluation and enhancement of the web site through continued review and public input will continue throughout the study period. Data will continue to be uploaded as it is processed.

3.4 TREND ANALYSIS WITH GROUNDWATER MODELING

The adapted groundwater model will continue to be used throughout the Study. The most recent model runs were made in 2005 and reported in August 2005. The next sequence of modeling is scheduled to occur during the next reporting period and will primarily be a calibration check to determine if adjustments need to be made in any of the input parameters to the model.

4.0 PROJECT SCHEDULE

The 5-year Study commenced on August 7, 2002 with award of the grant by EPA. All real-time and seven of the eight ADL monitoring points were in operation prior to the first surface water use by the three industries.

Milestones completed to date include:

- Submittal (and subsequent revisions) of QMP and QAPP.
- Web site development, host selection, and web site launch.
- Installation of two real-time water level monitoring wells (Welcome Center and Union School) and two monitoring wells for automated water level monitoring (Strong and Hilo).
- Installation of real-time water-level monitoring equipment at eight locations, including the two new monitoring wells.
- Installation of automated data loggers at eight locations.
- Seven rounds of semi-annual groundwater sampling.
- Groundwater modeling.

Milestones to be completed during the next reporting period include:

- Eighth round of semi-annual groundwater sampling (July 2006).
- Progress report No. 8 (August 2006).

Appendix D contains a milestone list that shows the starting and completion/anticipated completion date for each task. The decision to retain the Institute for Economic Advancement (IEA) to host and maintain the Study web site (www.ucwcb.org) permitted the elimination of Milestone 3.2 (purchase of web-site hosting equipment).

5.0 REFERENCES

B&McD. December 2004. *Quality Assurance Project Plan, Revision 2 – Sparta Aquifer Recovery Study.* Burns & McDonnell Engineering Co. Kansas City, Missouri.

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Appendix A

Ouachita River Water Supply Project Description

Project to Restore Sparta Aquifer

Union County Water Conservation Board – El Dorado, Arkansas

Relevant Tasks

- Hydrogeologic Modeling
- Evaluate Alternative Supplies
  - Aquifer Storage and Recovery
  - Dam and Reservoir
  - Wastewater Reuse
  - River Supply
- 65-MGD River Intake
- Industrial Pretreatment Facility
- Ground Storage and Booster Pump
- 23 Miles of 16" to 48" Pipeline
- 32.5-MGD Pretreatment Solids Settling
- Storage Reservoir & Pump Station
- Property Ownership Easement Procurement
- Regulatory Agencies Coordination
- Rate Analysis
- Financial Planning

Completion Date

2004

Construction Cost

$52,300,000 (Estimated)

Client Reference

Mr. Robert Reynolds, President
Union County Water Conservation Board
214 N. Washington St. Suite 220
El Dorado, Arkansas 71730
(870) 863-7234

South Central Arkansas obtains its raw water supply from the Sparta Aquifer. Over the past 50 years the Sparta has been declining with the cone of depression centered under El Dorado, Union County Arkansas. In April 1999, the Arkansas legislature passed Act No. 1050 authorizing the creation of groundwater conservation boards in counties designated as "critical groundwater areas". The first county to form such a board was Union County in south central Arkansas, bordering Louisiana. A U.S. Geological Survey (USGS) monitoring well near the center of the county recorded a static water level in 1942 of 60 feet *above* sea level. By 1999, the static level in the same well had dropped to 180 feet *below* sea level. This represents an average depletion of 4.2 feet per year over the 57 years of records.

The Board retained the services of engineering consultants Burns and McDonnell to develop a master plan to supply raw water from the Ouachita River to area industries and thereby eliminate the need for industries to use groundwater. The Ouachita River supports barge traffic and is a controlled release waterway by means of a Corps of Engineers Lock and Dam upstream of El Dorado, Arkansas. This surface water supply carries high solids concentrations during the spring rainy season. The master plan recommended that a settling facility be constructed to allow industries to utilize this raw water source and to lessen the cost for future potable water treatment. Preliminary design of a 65-MGD River Intake and pump station, settling facilities and 5 miles of 48-inch pipeline was completed in several contracts and constructed by others through the design-build method in Phase I.

Hydrogeologic modeling performed by the USGS of the Sparta aquifer covering southern Arkansas and northern Louisiana predicted that the groundwater usage must be reduced from a maximum of 25 million gallons per day (MGD) to an average of approximately 7 MGD to restore the aquifer to its original levels over in 30 years.

The Board refined the USGS model of the Sparta aquifer to represent the information collected in Union County, which covers over 1000 square miles. Nearly all water use in Union County comes from the Sparta aquifer. There are seven cities, 22 rural water associations and eleven major industries using Sparta water. Many wells were metered as a part of this project, as Arkansas legislation allowed the County to charge $ 0.24 per 1000 gallons for all water pumped from the Sparta. This revenue source allowed the Board to develop a master plan to "Save the Sparta."

In addition, a new merchant power plant was planned for the County that will have an average daily demand of around 20 MGD, supplied by the Ouachita River. Well location data and pumping information were used to model the aquifer for several alternatives. Alternatives considered for supplemental supply included the Ouachita River; aquifer storage and recovery; (five) dams and surface water reservoirs; and wastewater reuse.

The selected alternative was to provide non-potable water to the new power plant and to major industries in Union County by constructing a 65-MGD intake on the Ouachita River. Water treatment is limited to coagulation and sedimentation. The settled water is pumped to the power plant, then on to a storage tank and pump station near El Dorado, where it will be boosted to serve the largest industries.

Conventional design, bid, and construction methods are being used on the 3-million gallon tank, pumping station and 14-mile pipeline for Phase II. A rate study established the recommended base rate of cost for the raw water supply to the industries. Phase II design is nearing completion and construction is anticipated to begin in late summer 2002.

The 14-mile transmission system needed to support the delivery of non-potable water for these industrial users consists of pipeline ranging in size from 12 inches to 48 inches. Design and permit considerations included state roadway crossings, railroad crossings, lake crossings and wetland construction issues. The pipeline alignment was selected with consideration being given to existing development and the ability to construct the pipeline. Most of the pipeline alignment is parallel to overhead power transmission systems. Temporary construction area was provided on the power line right-of-way with specific safety requirements stipulated by the power utility. Permanent easements for pipeline and temporary construction easements are less costly when obtained adjacent to existing easements.

Construction in wetland areas is closely monitored and provisions must be provided to assure that the insitu material is segregated and replaced within the same strata. The natural flow of water in the wetland must be maintained across the work area. Temporary fill material is allowed, however it must

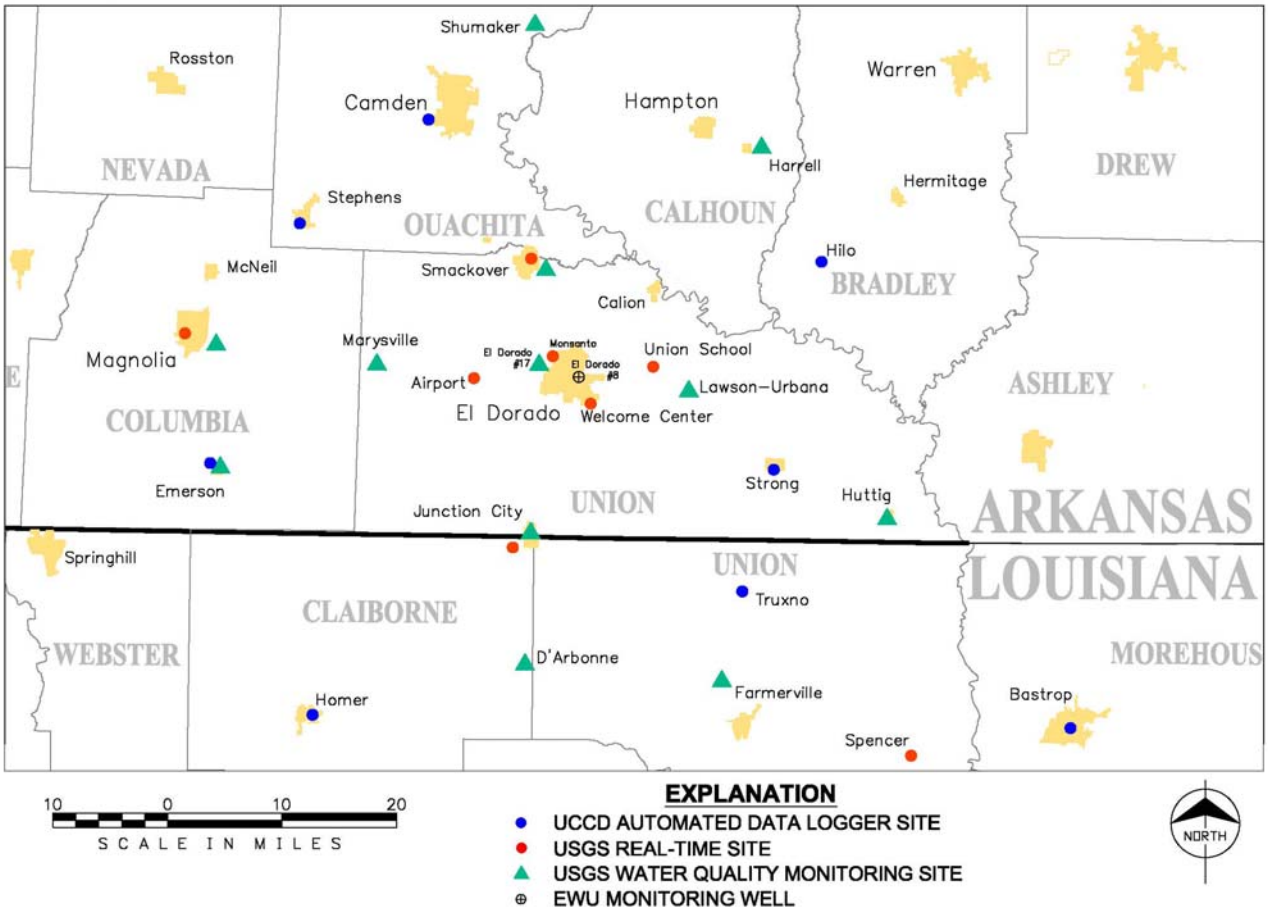
be removed within 90 days following installation of the pipeline. This prevents permanent damage to the wetland and assures that minimal disturbance has occurred.

Groundwater levels will be monitored for several years to determine the rate of recovery of the aquifer from Phases I and II of the project. If the rate of recovery is not acceptable, then a second tier of industrial users will be taken off groundwater and added to the non-potable surface supply as Phase III of the project. Phase IV, if needed, will be to provide a membrane water treatment plant near the storage tank to provide potable water to a portion of the County.

Appendix B

Well Summary

Sparta Aquifer Recovery Study Wells



NOTE: The EWU (El Dorado Water Utilities) Monitoring Well is equipped with a data logger maintained by USGS and downloaded quarterly. The well is being considered for inclusion in the Study's monitoring network.

Well Summary

Water Quality Monitoring Wells ▲

D'Arbonne (LA) Well 5
El Dorado Well #17
Emerson Water 2
Farmerville (LA) Well 3
Harrell Well 1
Huttig Well 2
Junction City Well 2
Lawson-Urbana W2
Magnolia Well 8
Marysville Well 1
Shumaker Well 4
Smackover Well 7

Real-Time Water Level Monitoring Wells ●

El Dorado – Monsanto
El Dorado - Welcome Center
El Dorado - Airport
Junction City
Magnolia
Smackover
Spencer (LA)
Union

Automated Data Logger Water Level Monitoring Wells ●

Camden
Emerson
Homer (LA)
Stephens
Strong
Truxno (LA)
Bastrop (LA)
Hilo

Appendix C

USGS Laboratory Results
January 2006

DATES Date as yyyymmdd
TIMES Sample start time
STAID Station number
MEDIM Medium code 6 - Regular sample, S - QA/QC sample, duplicate or trip blank
P00095 Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius
P00010 Temperature, water, degrees Celsius
P00940 Chloride, water, filtered, milligrams per liter
#

DATES	TIMES	STAID	Station	MEDIM	R00095	P00095	R00010	P00010	R00940	P00940
						Specific Conductance in uS/cm		Temperature, degrees Celsius		Dissolved Chloride Concentration, mg/L
1/31/2006	1230	325004092260801	UN- 202	6		1270		22.6		217
1/31/2006	1240	325004092260801	UN- 202	S		1270		22.6		217
1/31/2006	1245	325004092260801	UN- 202	S		1270		22.6		
1/30/2006	1710	325103092434901	CL- 150	6		561		22.7		44.3
1/30/2006	1715	325103092434901	CL- 150	S		561		22.7		44.3
1/30/2006	1810	330107092432301	19S16W35DDC1	6		600		22		101
1/30/2006	1815	330107092432301	19S16W35DDC1	S		600		22		100
1/30/2006	1820	330107092432301	19S16W35DDC1	S		600		22		101
1/31/2006	1050	330219092111201	19S11W25AAA1	6		1150		19.3		212
1/30/2006	1425	330555093112801	19S20W09CBD1	6		210		21.3		3.21
1/31/2006	1600	330555093112801	19S20W09CBD1	S		TRIP BLANK				
1/31/2006	0950	331203092290801	17S13W31BAD1	6		775		17.8		93
1/30/2006	1600	331351092572701	17S17W30DCD1	6		354		23.5		9.15
1/31/2006	0745	331358092424301	17S16W24BDB1	6		472		18.6		22.6
1/30/2006	1330	331519093115901	17S20W17CDA1	6		406		20.5		5.61
1/30/2006	1040	332113092421001	16S16W01DDD1	6		493		19.8		19.8
1/30/2006	0940	333040092240301	14S13W12CCB1	6		463		20.5		13.9
1/30/2006	1150	333944092430401	12S16W26AAD1	6		177		18		8.02

Appendix D

Milestone List

Appendix D -
Milestone List

Task Number	Subtask Number	Description	Start Date	Completion Date
1	**1.1**	Installation of two new monitoring wells	08/05/2003	08/12/2003
	1.2	Installation of real-time monitoring equipment in new and existing monitoring wells	07/15/2003	08/15/2003
	1.3	Installation of automated data loggers in existing monitoring wells	03/10/2004	12/16/2004
2	**2.1**	Groundwater sampling, semi-annual	01/31/2003	07/31/2007[1]
3	**3.1**	Web site development	11/01/2002	04/30/2003
	3.2	Web site hosting equipment purchase	03/01/2003	Milestone eliminated[2]
4	**4.1**	Submittal of Quality Management Plan[3]	06/19/2002	07/19/2004
	4.2	Submittal of Quality Assurance Project Plan[3]	10/01/2002	12/13/2004
	4.3	Progress reports to EPA, semi-annual	01/31/2003	09/30/2007[1]
	4.4	Final report	09/30/2007[1]	09/30/2007[1]

[1] Anticipated completion date
[2] Contract to UALR-IEA for web site hosting eliminated need for equipment purchase
[3] Includes revisions (start date represents first submittal, completion date latest revision)