August 2001

Implementation Plan for Sulfate and Total Dissolved Solids TMDLs in the E. V. Spence Reservoir

For Segment 1411

Prepared by the:

Strategic Assessment Division, TMDL Team

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

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Introduction

In keeping with Texas' commitment to restore and maintain water quality in impaired water bodies, the Commission recognized from the inception of the total maximum daily load (TMDL) program that implementation plans would need to be established for each TMDL developed.

The TMDL is a technical analysis that 1) determines the maximum loadings of a pollutant a water body can receive and still attain and maintain its water quality standards, and (2) allocates this allowable loading to point and nonpoint source (NPS) categories in the watershed. Based on the TMDL, an implementation plan is then developed. An implementation plan is a detailed description and schedule of the regulatory and voluntary management measures necessary to achieve the pollutant reductions identified in the TMDL, and a schedule under which the commission anticipates TMDL implementation will proceed. The plan is a flexible tool that governmental and non-governmental agencies involved in TMDL implementation will use to guide their program management. Actual implementation will be accomplished by the participating entities by rule, order, guidance, or other appropriate formal or informal action.

The implementation plan contained herein will provide the following components: (1) a description of the control actions and management measures[1] that will be implemented to achieve the water quality target; (2) legal authority under which control actions and management measures will be carried out and whether they are enforceable; (3) the development of a schedule for implementing specific activities determined necessary to achieve TMDL objectives; (4) a follow-up surface water quality monitoring plan to determine the effectiveness of the control actions and management measures; (5) reasonable assurances that the implementation of voluntary management measures will achieve the load allocations for NPS; and (6) measurable outcomes for determining whether the implementation plan is properly executed and water quality standards are being achieved.

This implementation plan is designed to achieve the reductions in the annual-average concentration and total-annual loading of sulfate and total dissolved solids (TDS) in the E.V. Spence Reservoir watershed as defined in the approved TMDLs. This implementation plan was prepared by the TMDL Team in the Strategic Assessment Division of the Office of Environmental Policy, Analysis, and Assessment of the Texas Natural Resource Conservation Commission (TNRCC). Technical assistance was provided by the Colorado River Municipal Water District (CRMWD)

[1] Control actions refer to regulatory pollutant reduction strategies, generally TPDES permits. Management measures refer to non-regulatory pollutant reduction strategies, generally voluntary best management practices.

This implementation plan was approved by the TNRCC on August 10, 2001. The implementation plan, combined with the TMDL, establishes a Watershed Action Plan (WAP). A WAP provides local, regional, and state organizations a comprehensive strategy for restoring and maintaining water quality in an impaired water body. TNRCC has ultimate responsibility for ensuring that water quality standards are restored and maintained in impaired water bodies. However, the Railroad Commission of Texas (RRC), the CRMWD, and the Texas State Soil and Water Conservation Board (TSSWCB) have key responsibilities for certain aspects of this implementation plan.

Summary of TMDL

The E. V. Spence Reservoir is located on the Colorado River just north of San Angelo and southeast of Big Spring in Coke County, Texas. The reservoir's watershed includes a large area of Texas and New Mexico and covers 15,278 square miles. A majority of this drainage area, 10,260 square miles, is part of the High Plains Region and does not normally contribute runoff or pollution to the main stem of the Colorado River above the reservoir. Figure 1 illustrates the portion of the drainage area above E.V. Spence Reservoir evaluated in the TMDL Study.

E. V. Spence Reservoir was placed on the 1998 Clean Water Act Section 303(d) List because sulfate and TDS concentrations exceeded the segment standards criteria of 450 milligrams per liter (mg/L), and 1,500 mg/L, respectively. In April 1999, the TNRCC and the CRMWD agreed to develop TMDLs for sulfate and TDS in the E.V. Spence Reservoir. The TMDLs were adopted by the Texas Natural Resource Conservation Commission on November 17, 2000, and submitted to the EPA for approval.

Stakeholders participated throughout the TMDL project through a 14 member watershed steering committee. Members of the steering committee represented the general public, environmental interests, municipalities, industry, agriculture, water districts, river authorities, and state and federal agencies. A technical subcommittee was formed to address technical issues such as modeling, and to provide recommendations to the steering committee.

Monthly chloride, sulfate, and TDS loading capacities over the 28-year period of record were estimated using an updated reservoir water quality model. Once the series of loading capacities was established, the loading capacity values were ranked in order of magnitude. In recognition of the climatological limitations associated with this portion of Texas, the 80th percentile loading capacity, i.e. the loading capacity that would be present in the reservoir 80% of the time, was selected as the target loading capacity.

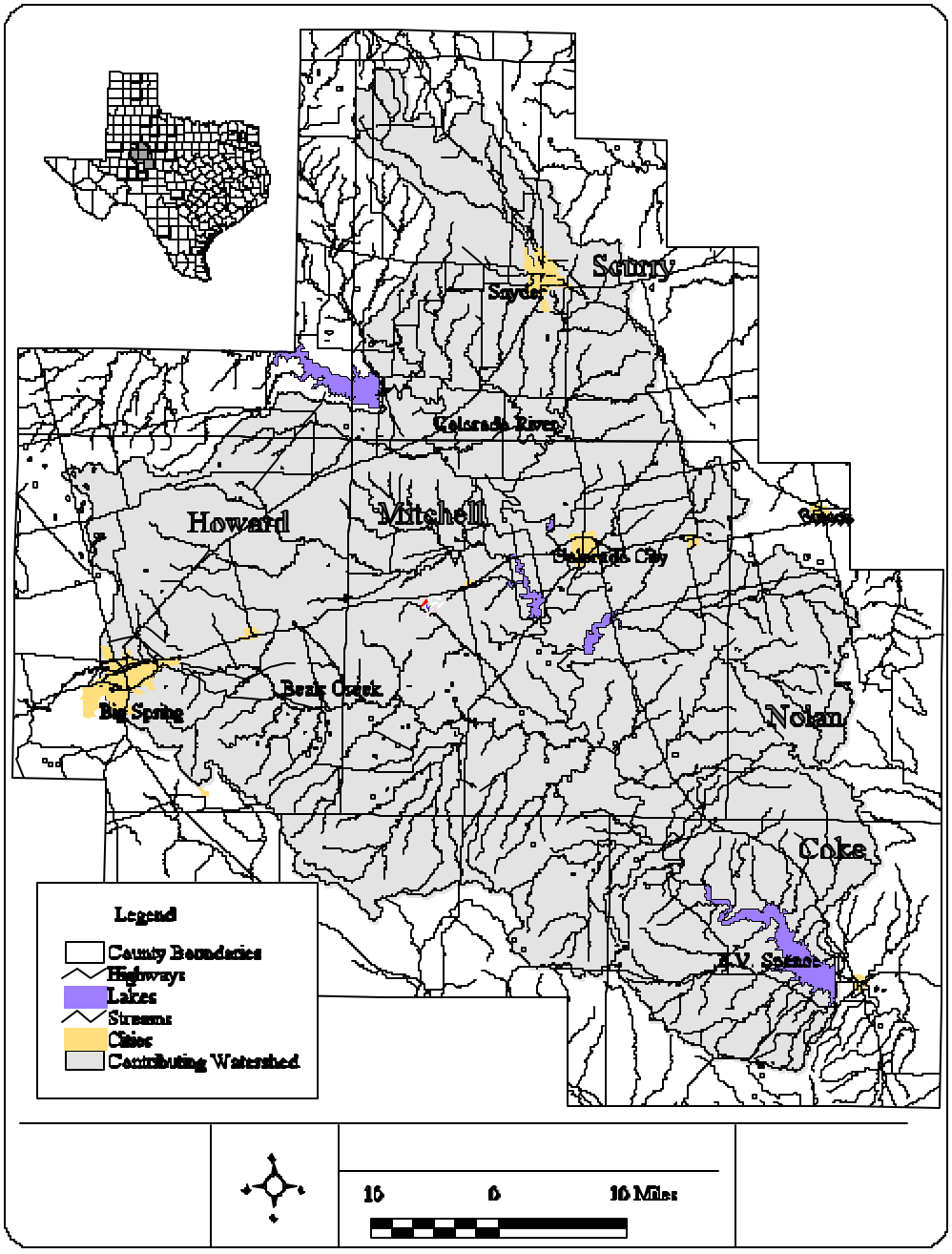

Figure 1. E.V. Spence TMDL Study Area

Monthly estimates of the point source loads in the watershed were derived from each facility's full-permitted flows and monitoring data collected by CRMWD just downstream of the discharge outfalls. For each parameter, the difference between the target loading capacity and the point source load represents the allowable loading contribution from nonpoint sources, with 44% of that remainder assigned to man-made nonpoint sources and 56% assigned to natural sources, in accordance with a U.S. Geological Survey (USGS) assessment by Slade & Buszka (1994). Table 1 shows the distribution of the 80th percentile loading capacities to each of these source categories.

Table 1 - Loading Allocation for Source Categories in the E.V. Spence Reservoir

Constitu-ent	E.V. Spence Reservoir Water Quality Standard (mg/L)	80% Simulated Loading Capacity (tons/day)	Loading Allocation to Big Spring WWTP (tons/day)	Loading Allocation to Snyder WWTP (tons/day)	Loading Allocation to Natural Nonpoint Sources (tons/day)	Loading Allocation to Man-made NPS (tons/day)
Chloride	950	1,427	17.44	2.12	788	619
Sulfate	450	268	9.04	0.96	144	114
TDS	1,500	438	40.27	5.21	220	173

Control Actions and Management Measures

Load reduction scenarios were modeled to determine the appropriate loading capacities for the TMDL utilizing a suite of pollutant reduction strategies recommended by the TNRCC and the E.V. Spence Reservoir TMDL Steering Committee. The pollutant reduction strategies that were considered can be classified into the following four major categories: Point Source Controls, Modifications of E.V. Spence Reservoir Operations, Water Quality Diversions, and Watershed Modifications. This classification is based on similarities of potential sources of target contaminants and the type of activities involved.

The E.V. Spence Reservoir water quality model was used to predict concentrations of chlorides in E.V. Spence Reservoir that would occur if the practice were implemented consistently during the entire simulation period. Chloride concentrations were evaluated for all the practices because of the greater availability of chloride measurements within the watershed and because chloride has fate and transport properties similar to the other pollutants of concern. The pollutant reduction strategies evaluated using the water quality model are summarized in Table 2.

Table 2 Summary of Pollutant Reduction Strategies

Category	Pollutant Reduction Strategy
Point Source Controls	Revision of Municipal Discharge Permits
Modifications of E.V. Spence Reservoir Operations	Release Management Diversion Management
Water Quality Diversions	CRMWD Water Quality Diversions
Watershed Modification	RRC Well Plugging Program Weather Modification Remediation of Magnesium Plant Site Targeted Brush Control

Where possible, the impact of the proposed management practice was quantified in terms of the flow and/or mass loadings received by E.V. Spence Reservoir. Once the flow and loadings to E.V. Spence Reservoir were quantified, the water quality model was used to estimate average and end-of-period concentrations of chloride in the E.V. Spence Reservoir.

All of the evaluations simulated future conditions based upon historic hydrology and mass loading estimates from January 1, 1972, to March 31, 2000, with adjustments to reflect existing watershed conditions. Historical water quality management efforts, such as the construction and enlargement of reservoirs and water quality diversions, were accounted for within the database. The adjustments made it possible to remove hydrology and mass loadings from upstream watersheds and sources to reflect historical conditions, current conditions, or future conditions that would result from the implementation of a pollutant reduction strategy.

Figures 2, 3, and 4 show the expected chloride, sulfate, and TDS concentrations, respectively, that result from a simulation of the suite of management measures considered by the E.V. Spence Steering Committee and the TNRCC. Figure 5 shows the frequency of exceeding the existing standards if all of these management measures are implemented. As shown in Figure 5, the load reduction scenario produces reservoir TDS concentrations that meet the existing standard approximately 80% of the time. When compared with the existing management conditions (i.e. "base case") scenario, this corresponds to a 39.6% reduction in the 80th percentile TDS concentration. The same load reduction scenario also produces reservoir sulfate concentrations that meet the existing standard approximately 90% of the time. This corresponds to a 38.9% reduction in the 80th percentile sulfate concentration. Table 3 shows the corresponding parameter concentrations associated with each scenario and the total percent reduction required for each parameter in order to achieve all water quality standards at least 80% of the time.

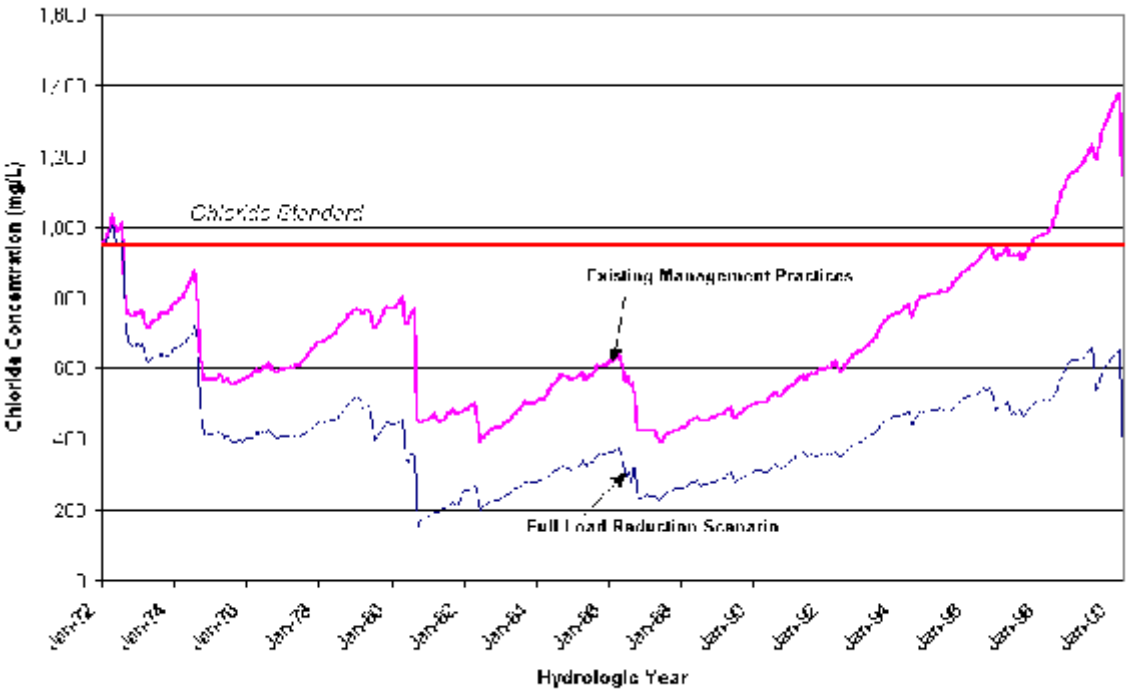

Figure 2 - E.V. Spence Reservoir Chloride Concentrations under Load Reduction Modeling Scenario

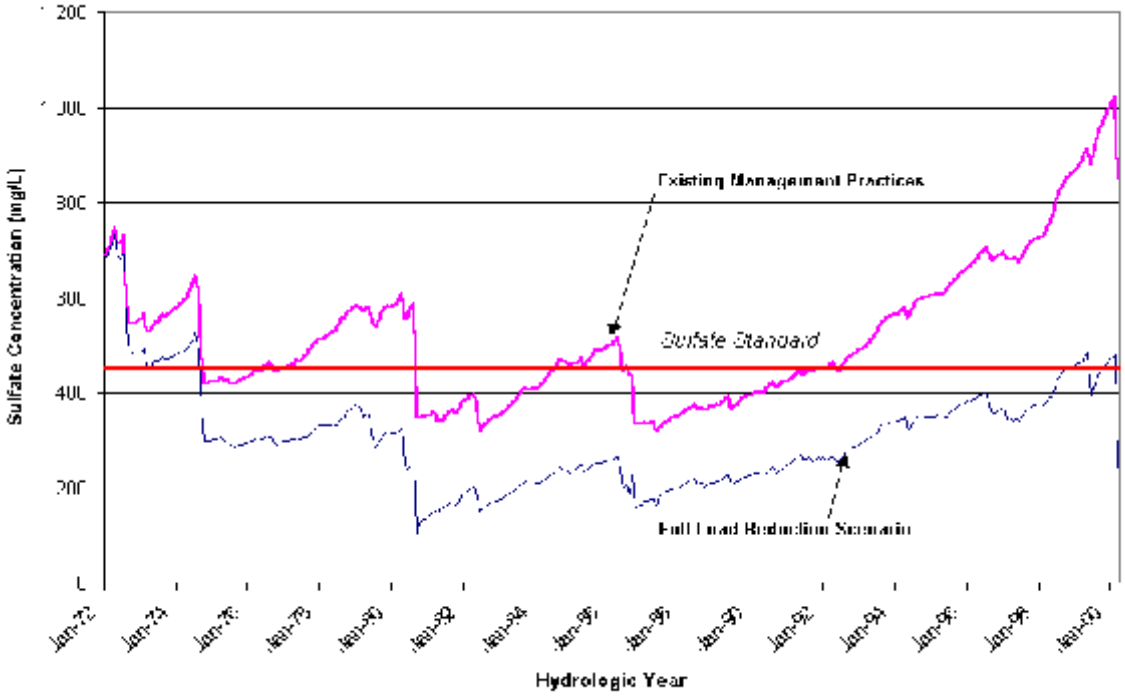

Figure 3 - E.V. Spence Reservoir Sulfate Concentrations under Load Reduction Modeling Scenario

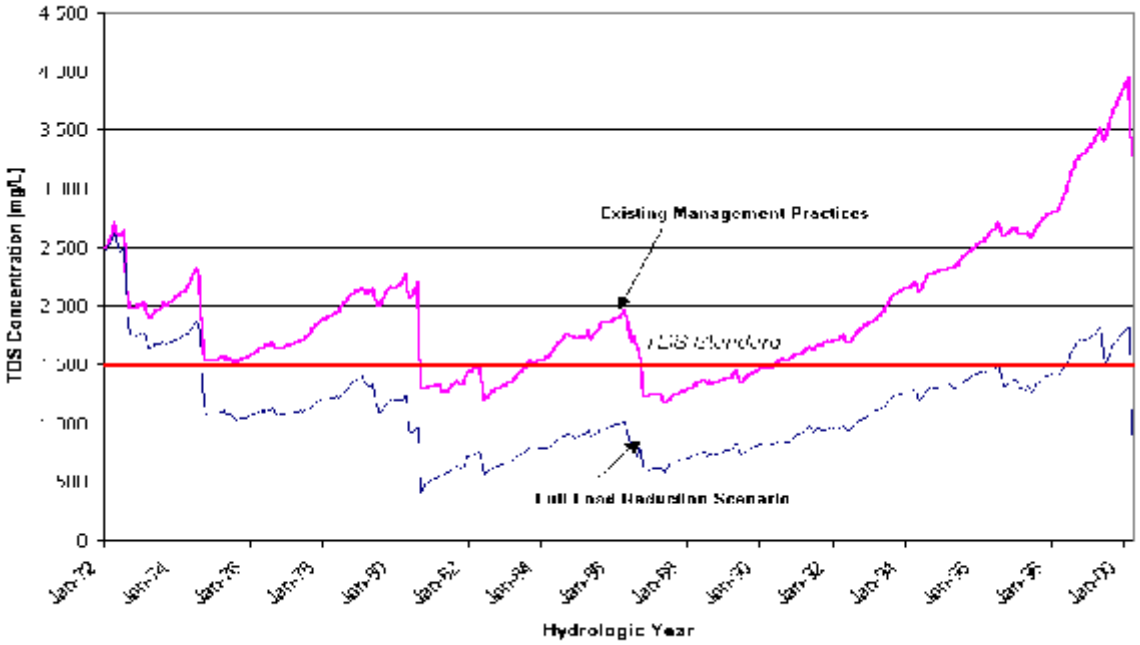

Figure 4 - E.V. Spence Reservoir TDS Concentrations under Load Reduction Modeling Scenario

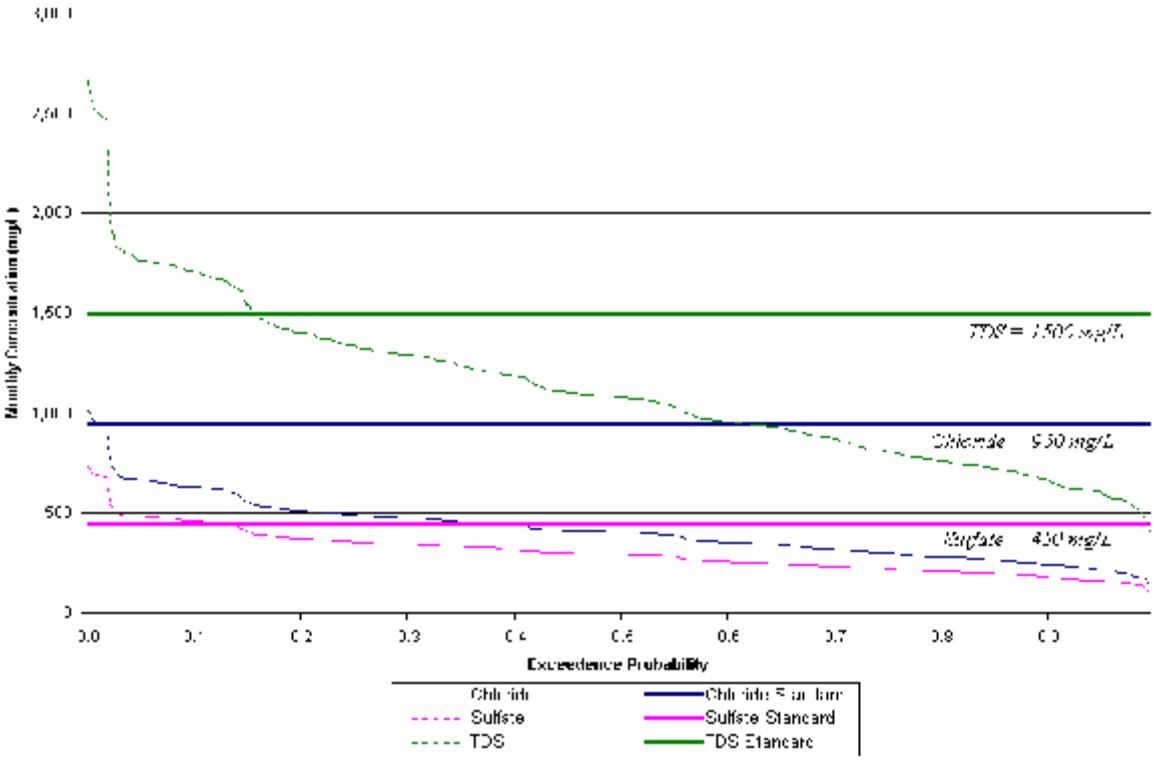

Figure 5 - Exceedence Frequencies for the Load Reduction Scenario

The remaining parts of this section provide information collected for the evaluation of individual measures or controls proposed by the TNRCC and the E.V. Spence Reservoir TMDL Steering Committee for consideration in improving water quality in E.V. Spence Reservoir. Although a subsequent section will discuss the schedule of implementation measures and the phased approach to this implementation plan, this section also organizes the description of management measures into each phase of implementation.

Table 3 - Comparison of 80th Percentile Concentrations for the Load Reduction and Existing Management Conditions Modeling Scenarios

Constituent	E.V. Spence Reservoir Water Quality Standard (mg/L)	80% Concentration For Full Load Reduction Scenario (mg/L)	80% Concentration For Existing Management Conditions (mg/L)	Total Percent Reduction
Chloride	950	513	833	38.4%
Sulfate	450	376	615	38.9%
TDS	1,500	1,405	2,326	39.6%

POINT SOURCE CONTROLS

Pollutant loads were allocated in the TMDL for the two municipalities, the city of Big Spring and the city of Snyder, that discharge wastewater effluent to tributaries of the Colorado River upstream of E.V. Spence Reservoir. Other municipal wastewater producers in the watershed employ land application as their primary disposal method, resulting in no contaminant loading to streams in the reservoir's watershed. The two wastewater treatment plants were not determined to be significant contributors of TDS or sulfate to the reservoir. Therefore, control actions for these point sources were not included in the implementation schedule since the facilities were allocated their full-permitted load within the TMDLs.

PHASE I

Modification of E.V. Spence Reservoir Operations

The operation of E.V. Spence Reservoir is an important factor that contributes to its water quality. The water quality model predicts reservoir concentrations of chloride, sulfate, and TDS based on estimates of monthly pollutant loads, inflows, net reservoir evaporation, demand, releases, and seepage. The latter four factors are all affected by reservoir operations. CRMWD manages the operations for E.V. Spence Reservoir. The water quality model was used to simulate the impact of management measures that provided reservoir releases and diversions.

Release Management

The current release management measure requires daily releases for the protection of threatned species found downstream of the reservoir. The measure requires daily releases of water at 10 cubic feet per second (cfs) to provide sufficient flow for the habitat of the Concho Water Snake (7,245 acre-feet per year). The following release management measures were evaluated with the model:

Base: Current required releases (10 cfs) for the Concho water snake

A. Double the daily minimum release (20 cfs)

B. Double the daily minimum release during periods when inflow to the reservoir was less than 1,200 ppm Cl.

C. Large (3,500 acre-foot per month) releases when inflow quality was less than one fourth of the average reservoir concentration.

The impact of all the release management measures on the water quality of E.V. Spence Reservoir is shown in Figure 6. The Steering Committee recommended management measure (B) that doubles the daily minimum release when inflow to the reservoir is less than 1,200 ppm for Cl. An increase in the daily minimum release is dependent upon reservoir use and volume, but additional releases are allowed under the current CRMWD water rights permit.

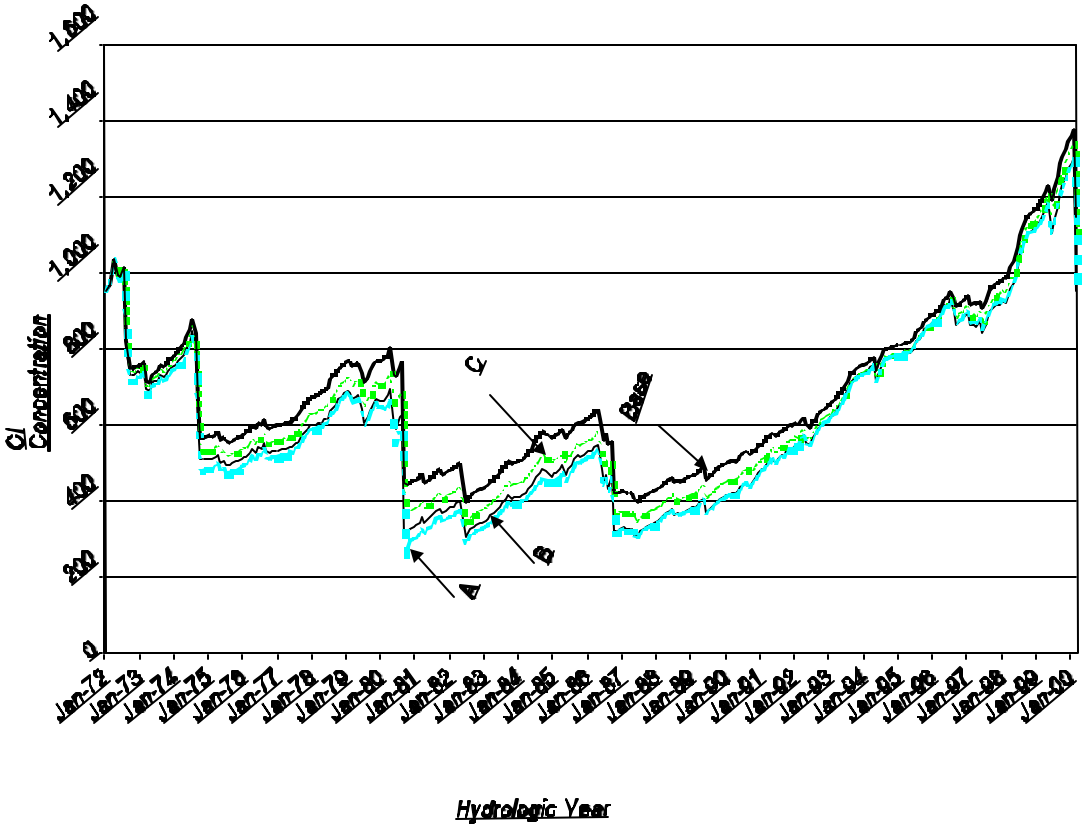

Figure 6. E.V. Spence Concentration Variation with Release Management

Diversion Management

The current diversion management measure provides for diversions into existing reservoirs dependent upon the water quality of the Colorado River as well as the demands of the users of the highly mineralized water. The diversion system delivers the water to oil companies for use in oil field secondary recovery operations. The following diversion management measures were specifically modeled:

Base: Annual demands varying with E.V. Spence Reservoir water quality.

E. 6,000 acre-foot per year demand independent of water quality

F. 2.72 times the Base case annual demands producing a 1,000 acre-foot minimum content in E.V. Spence Reservoir during the period of record

G. 1.50 times the Base case annual demands

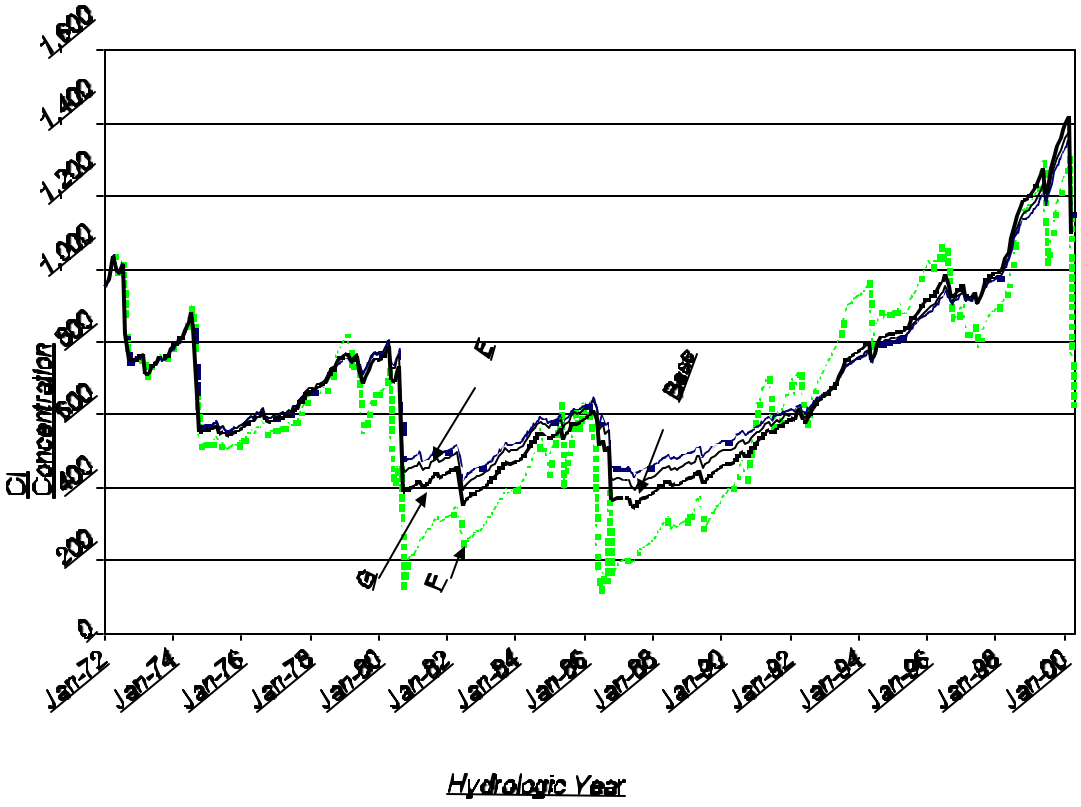

Figure 7. E.V. Spence Concentration Variation with Diversion Management

The impact of the various demand policies on the water quality of E.V. Spence Reservoir is shown in Figure 7. The Steering Committee recommended management measure (G) that increases the base case annual demands by a multiplier of 1.5. Adjudication Certificate No. 14-1008A gives the CRMWD authority to divert annually any portion of a total not to exceed 6,000 acre-feet of water. Additional diversions above 6,000 acre-feet will require an amendment to the existing permit or a new water rights permit. Also, special conditions allow certain diversions only at those times when the chloride content of the water at the diversion point equals or exceeds 500 ppm.

Water Quality Diversions

The CRMWD has directed efforts to mitigate pollution with the construction of diversions (Barber, Red Draw, Mitchell County, and Sulphur Draw Water Quality Reservoirs) from the Colorado River above Colorado City and Beals Creek upstream of Moss Creek, and the enlargement of Natural Dam (See Figure 8). The primary function of this system is to prevent the highly mineralized low flow of the Colorado River and Beals Creek (a tributary to the Colorado River) from reaching the E.V. Spence Reservoir. CRMWD has recorded diversions to all its salt-water control reservoirs and estimated mass load reductions at the diversion location. Using the data from CRMWD, it is estimated that historical diversions have removed 30% of the mass load and 8% of flow to the E.V. Spence Reservoir. Flow losses were estimated to be 0.5% per mile between the diversion locations and E.V. Spence Reservoir, and mass loads were assumed to be conservative.

The water quality model was used to evaluate the efficacy of existing and other potential diversions for mitigating future pollutant loads to E.V. Spence Reservoir. Daily reservoir operation models for each water quality reservoir were conducted to predict the impact of daily operations of existing diversions from Beals Creek and the Colorado River under different management practices. Estimates of the flow and mass loads that are available at each diversion location depend on management practices in place upstream and the demand measures that govern the diversions. Diversions are also limited by the pumping capacity of the diversion system, concentration estimates within the stream, and the storage capacity of the existing reservoirs. The optimum operation of the water quality reservoirs depends on the balancing of evaporative losses from the reservoirs against the ability of the reservoirs to capture poor quality water upstream of the diversion. The daily operation models made it possible to quantify mass loads and flows removed under various management measures based on reservoir trigger contents and stream concentrations and flows.

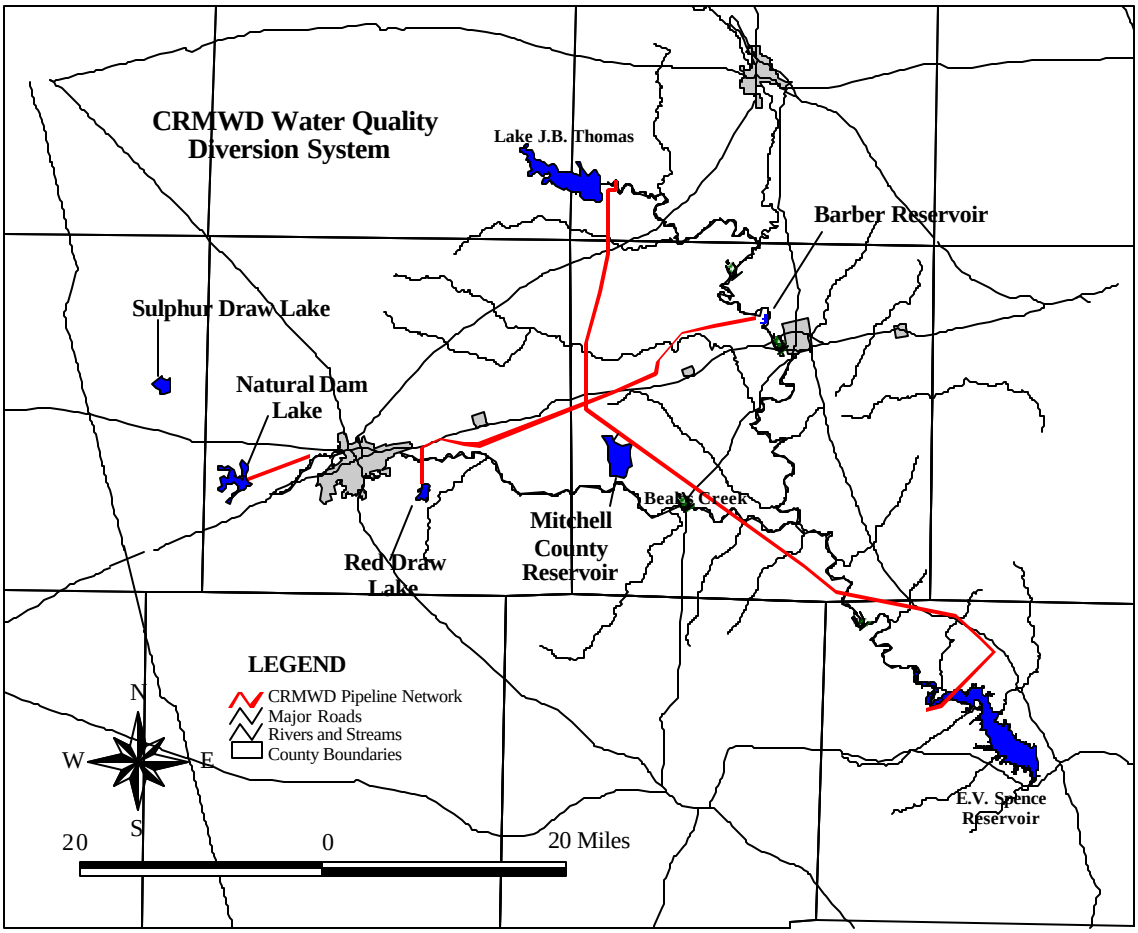

Figure 8. Components of the CRMWD Water Quality Diversion Operation

The E.V. Spence water quality model was used to determine the impact of the diversion management measures on the E.V. Spence Reservoir. The specific management practices that have been evaluated include BMPs H, I, J, and K.

Base:	Existing diversions in operation
H.	Increased diversions (up to 6 MGD) upstream of the city of Big Spring at 1-Mile Lake
I.	No diversions from 3 and 4-Mile Lake
J.	No diversions from Beals Creek downstream of Big Spring
K.	No diversions from the Colorado River near Colorado City

The impact of all the brackish water diversions on E.V. Spence Reservoir is shown in Figure 9. The Steering Committee recommended management measure (H) that increases diversions upstream of

the city of Big Spring. The construction of a new water quality diversion will require an amendment of the CRMWD water rights permit.

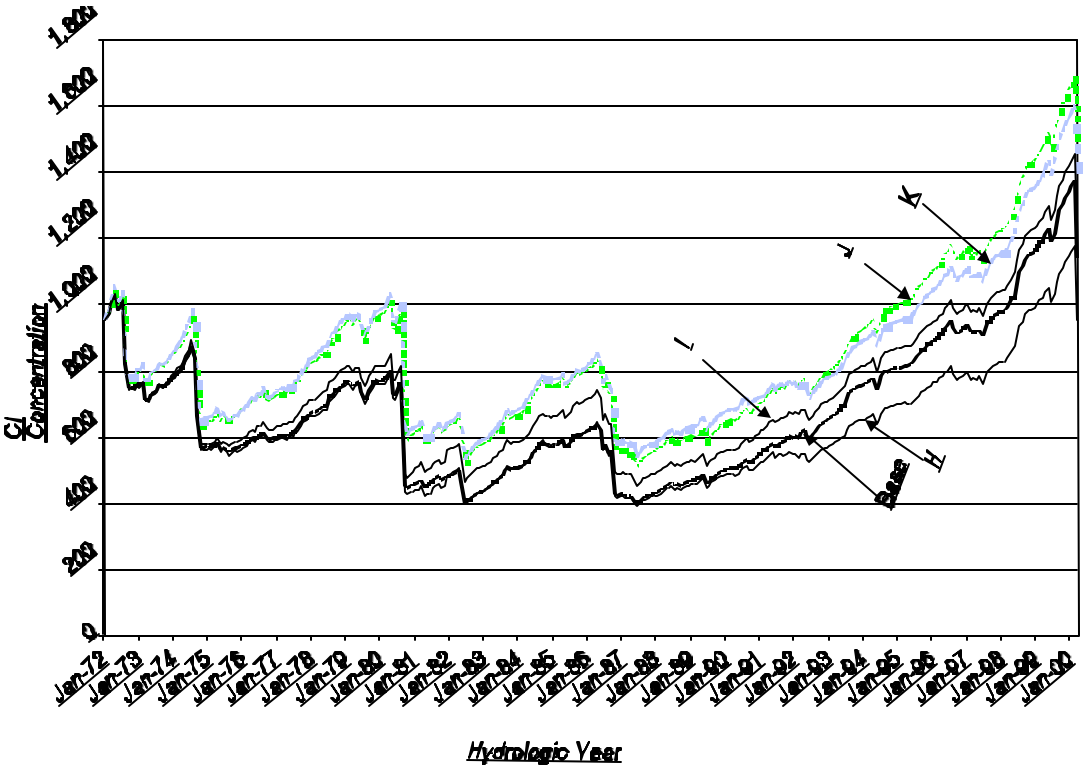

Figure 9. Impact of Brackish Water Diversions on E.V. Spence Chloride Concentrations

Watershed Modification

Texas Railroad Commission Well Plugging Program

The most significant sources of man-made NPS pollution contributing excessive loading of sulfates and TDS in the watershed of E.V. Spence Reservoir are associated with the oil and gas industry. Oil exploration has been a major industry in the watershed since the early 1920's. The total production in 1998 from fields in Mitchell, Scurry and Howard counties, which comprise the major portion of the E.V. Spence watershed, was approximately 17.9 million barrels (RRC, 1999). These sources include leaking oil well casings, improper brine disposal and the over pressurization of downhole formations. The RRC regulates production of oil and gas resources in the state. In this capacity, the RRC issues permits for production and injection wells, inspects oil and gas wells, and investigates complaints from the public. The RRC administers the Oil Field Cleanup Fund for the entire State. While the RRC has plugged over 15,000 wells and cleaned up over 1,300 abandoned oil and gas related sites in Texas with this fund (See Figure 10), there remain thousands of additional wells that have been identified as requiring proper plugging. Over the past several years, the RRC has been more aggressive in its well plugging program in areas where salinity problems have been attributed to oil field activities. The Upper Colorado River Basin, which includes the Spence Reservoir Basin, is an area that has been a focus of the RRC.

In 1999, the RRC and the TNRCC initiated a three-year project entitled the Upper Colorado River Salt-Water Minimization Project to fund additional oil and gas well plugging by the state. The ultimate goal of the project is a reduction of salinity in the E.V. Spence Reservoir drainage basin. The RRC plans to accomplish this goal by enhancing its current oil field cleanup program through the following project objectives.

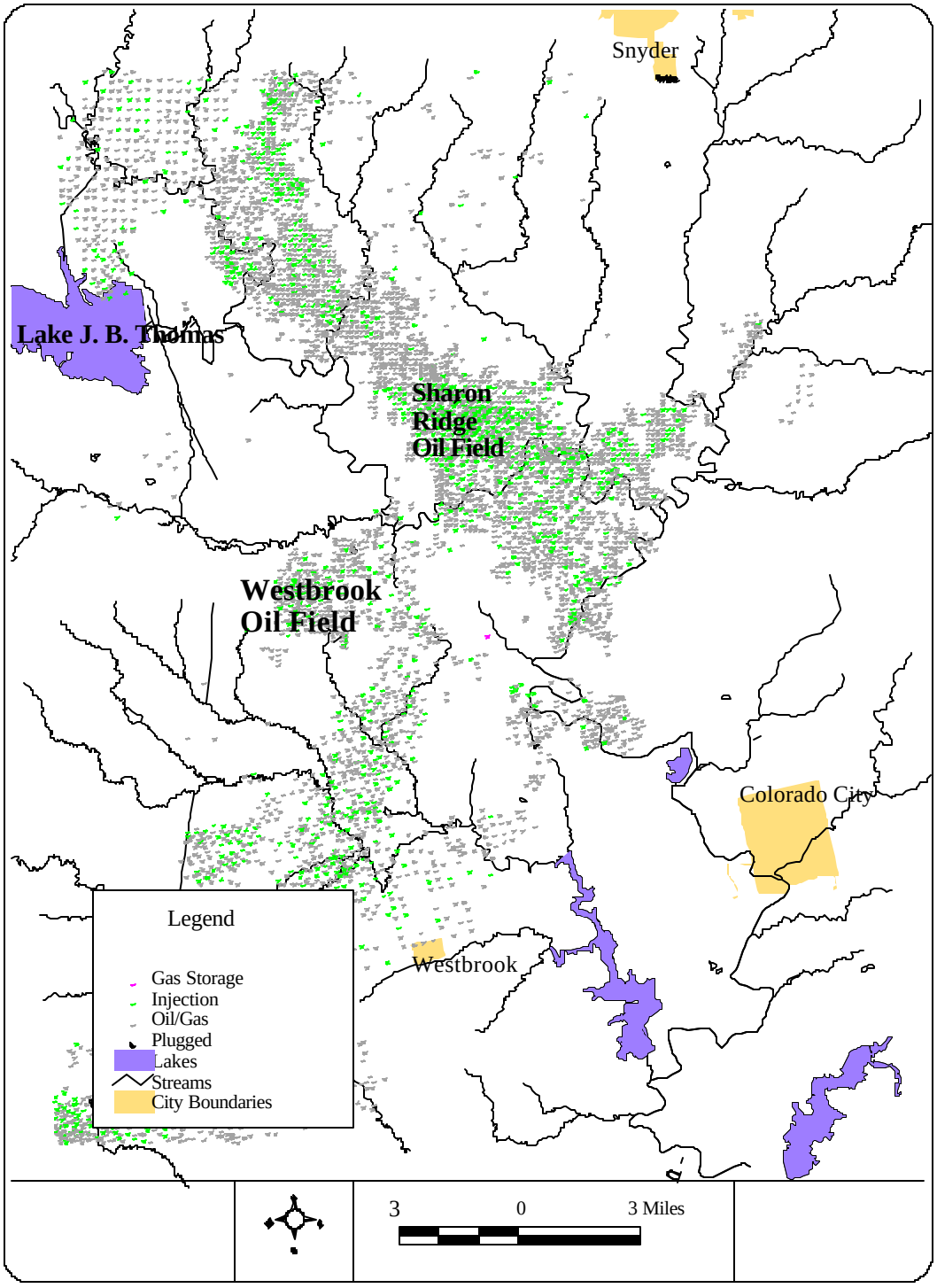

Figure 10. Oil and Gas Industry in the Spence Watershed

Properly Plug 171 Abandoned Oil and Gas Wells

This objective is to eliminate a source of salinity in the E.V. Spence Reservoir drainage basin through the plugging of wells at an estimated cost of $7,000 each based upon historical pluggings. It includes the selection of wells, the physical plugging of inactive non-compliant wells in the E.V. Spence Reservoir drainage basin, and the approval of well plugging invoices.

Snyder Oil Field Seep Assessment

This objective is to assess and define necessary remediation steps for four saltwater seeps located in the Snyder Oil Field and East Howard-Iatan Oil Field areas, Howard County, Texas. The saltwater seeps emanate from the near surface subcrop of the Ogallala Formation and discharge into intermittent streams and drainage ways that eventually lead to Beals Creek, a tributary of the Colorado River. Preliminary sampling of seep water indicates chloride concentrations ranging from 3,351 to 28,994 mg/L.

Assessment of Historical Oil Field Brine Pits

This objective is to assess and define necessary remediation steps for three saltwater seeps, which may be attributable to the historical use of oil field brine evaporation pits, located in the Vealmoor Oil Field, Borden County, Texas. The saltwater seeps emanate from the sides of draws and drainage ways and are located within a half mile of each other. Discharge from the seeps enters the drainage ways (which appear to be intermittent streams) that are part of the overall Colorado River Drainage basin. Preliminary sampling of seep water indicates chloride concentrations as high as 8,745 mg/L. The northernmost seep has apparently formed a marshy area with abundant phreatophyte vegetation, such as salt cedars. The southern seep "feeds" a stock pond, while the western seep flows on the surface till it eventually soaks into the loose soil at the base of the draw.

Vincent Oil Field Seep Assessment

This objective is to assess and define necessary remediation steps for a saltwater seep located in the Vincent Oil Field area, Northeast Howard County, Texas. The saltwater seep emanates from the side of a draw with discharge into an adjacent intermittent stream that eventually leads to the Colorado River. Preliminary sampling of seep water indicates chloride concentrations as high as 25,050 mg/L.

Monitor, Analyze Data & Submit Final Report

This objective is to analyze and assess TDS and chloride data both in E. V. Spence Reservoir and in the Upper Colorado River. The RRC has completed a Quality Assurance Project Plan approved by the TNRCC which will direct all monitoring efforts for the project. A comprehensive report on the activities conducted by the RRC during the course of the project will be available after August 30, 2002.

Weather Modification Program

CRMWD began its weather modification program in 1971 in a 14 county area in the watershed of E.V. Spence Reservoir. The objectives of the program are to determine the feasibility of increasing precipitation through the aerial application of silver iodide and to determine if surface water inflows can be increased for both Lake J.B. Thomas and E.V. Spence Reservoir. Additional surface water flows that reach the E.V. Spence Reservoir due to the weather modification are of relatively high quality. CRMWD is licensed by the TNRCC to perform these weather modification activities.

With the exception of 1987, 1989, 1992, and 1996, cloud seeding has been applied to 2.24 million acres of CRMWD watershed between the months of May and October since 1971. During these months, CRMWD has observed an approximate 21% increase in precipitation within the target area. This would correspond to an increase in runoff of 21%, under the assumption that precipitation and runoff are linearly related.

CRMWD's target area extends roughly from the Beals Creek watershed below Coahoma and the Lake J. B. Thomas watershed to the USGS gage above Silver. A large portion of the target area has not contributed runoff to E.V. Spence since the program started because the runoff has been captured by other reservoirs in the area. According to the USGS, the total drainage area that has contributed runoff to E.V. Spence Reservoir during the study period of the TMDL is 3,377 square miles. The estimated net effect of CRMWD's weather modification program to runoff in the watershed was an increase in runoff of approximately 7%.

PHASE II

Remediation of Magnesium Plant Site near Snyder

The magnesium plant is located approximately seven miles west of the city of Snyder at the intersection of FM1606 and FM1607. The plant is situated on the side of a slope approximately 3,000 feet west of Bluff Creek and approximately 1,000 feet north of an unnamed tributary to Bluff Creek. The site contains buildings of various sizes and in various states of disrepair, a tank farm, and several ponds for storage and catchment. The operating history of the facility began in 1973 under American Magnesium Company (AMC). AMC constructed a magnesium chloride concentration and purification unit on the site. AMC sold the plant to MPLC North American Magnesium, Inc. in 1982; MPLC sold the plant to World Wide Refining, Inc. in 1984; World Wide sold the plant to JHB Investments in 1987. The facility used an electrolytic process to purify magnesium metal from magnesium chloride brine solutions through 1983. World Wide Refining, Inc., used the site for oil reclamation and/or refining, although their processes are unknown. The plant utilized storage ponds and underground injection to dispose of the wastes from the site. The TNRCC regional office documented unauthorized discharges of high chloride water numerous times throughout the life of the plant. Operations were discontinued at the plant in 1987.

In 1996, the EPA retained TNRCC to complete an investigation of World Wide Refining, Inc. An on-site reconnaissance was performed to document current site conditions and identify potential sources of hazardous substances at the site. As part of the reconnaissance, a survey of the site's vicinity was completed to identify potential receptors of hazardous substance migration and potential exposure attributable to the site. Information concerning the environmental setting of the site was obtained to

describe the groundwater, surface water, soil exposure and air pathways. Available regulatory compliance files from Federal, State, and local government agencies were reviewed, and telephone interviews were conducted with authorities knowledgeable of the site and its surroundings. A Preliminary Assessment (PA) site reconnaissance was conducted on June 3 and 4, 1996. The major pathway of concern is soil exposure due to open public access and evidence of recent human activity on site. The groundwater pathway was evaluated and determined to be insignificant, and no evidence of an active air or surface water pathway was found.

A result of the PA is the preparation of a Hazard Ranking System (HRS) package. The HRS is a scoring system developed by the EPA that is used to evaluate potential threats to human health and the environment from hazardous waste sites. The HRS calculates a score from 0 to 100, based on the actual or potential release of hazardous substances that will affect human health or the environment from a site. The PA conducted on the magnesium plant resulted in a HRS score below 5. Sites that receive an HRS score of 5.0 or greater may be eligible for listing in the State Superfund Registry as state Superfund sites. The state Superfund registry, established by the 69th Texas Legislature in 1985 and administered by the TNRCC, lists those abandoned or inactive sites that have serious contamination but do not qualify for the federal program, and therefore are cleaned up under the state program.

In January of 1998, water samples were collected by CRMWD staff from a well near the property line and from a seep down-slope from the well. Chloride concentrations of the samples were 15,200 mg/L and 15,100 mg/L, respectively. Discharge from the seep was not measured, but was sufficient to cause a small flow across a nearby county road. An apparent kill zone was noted on both sides of the county road. The location of the site still presents a threat to the water quality of Bluff Creek and eventually to Colorado River. The CRMWD estimates that loads from the abandoned plant could be as much as 61.6 tons per month on average. The impact of eliminating discharge from the plant was estimated in BMP L, by removing a maximum of 61.6 tons of chloride per month from the inflow to E.V. Spence Reservoir. The impact of BMP L is shown in Figure 11.

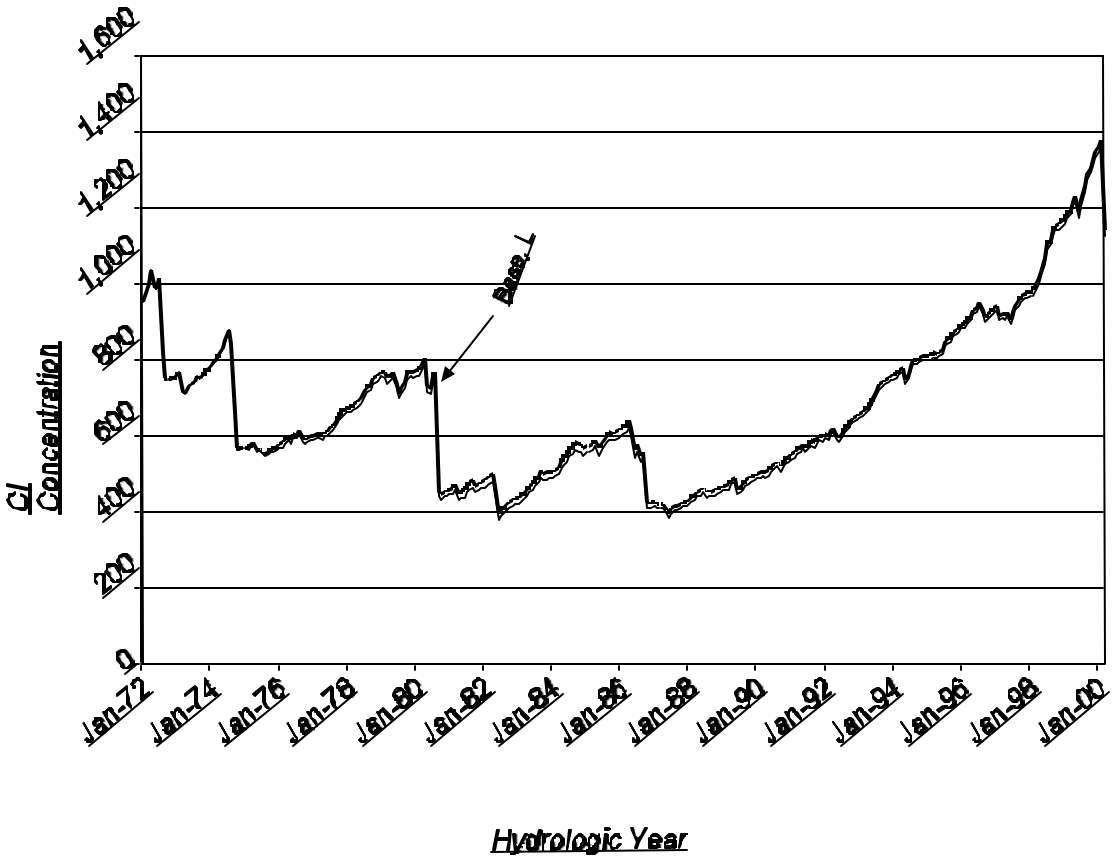

Figure 11. E.V. Spence Concentration Variation with Magnesium Plant Remediation

Targeted Brush Control

The proliferation of invasive species of brush into the western portions of Texas are a recognized problem in water management. Three species which occur in the E.V. Spence Reservoir watershed include juniper, salt cedar and mesquite. These plants have a high water consumption rate and easily out-compete most native species in disturbed areas. They have extensive root systems, robbing the soil of moisture to a depth impenetrable by other species. Every 10 acres of moderate to heavy brush infestation results in one acre-foot of water loss annually. Salt cedar is especially detrimental to water quality because of its ability to transport salts from ground water to its leaves. Because salt cedar is a deciduous plant, salt stored in the leaves is concentrated at the soil surface when leaves are dropped in the fall. Salt cedars can tolerate chloride concentrations as high as 35,000 mg/L, much higher than most plant species.

The State Legislature funded a brush control feasibility study for the Concho and Upper Colorado River watershed implemented by the Upper Colorado River Authority (UCRA) and Texas A&M

University. Computer modeling performed by Texas A&M shows that the E.V. Spence Reservoir watershed could gain an additional 41,000 acre-feet of water annually in groundwater recharge and surface flow into the reservoir (UCRA, 2000).

For the evaluation of brush management (BMP M), no additional mass loadings were assumed to accompany the runoff originating from brush control. Also, BMP M assumes brush control produces an estimated increase in watershed yield of 3,843 acre-feet per year to E.V. Spence Reservoir. For BMP M, Figure 12 shows the maximum expected benefit of brush control to E.V. Spence Reservoir chloride concentrations.

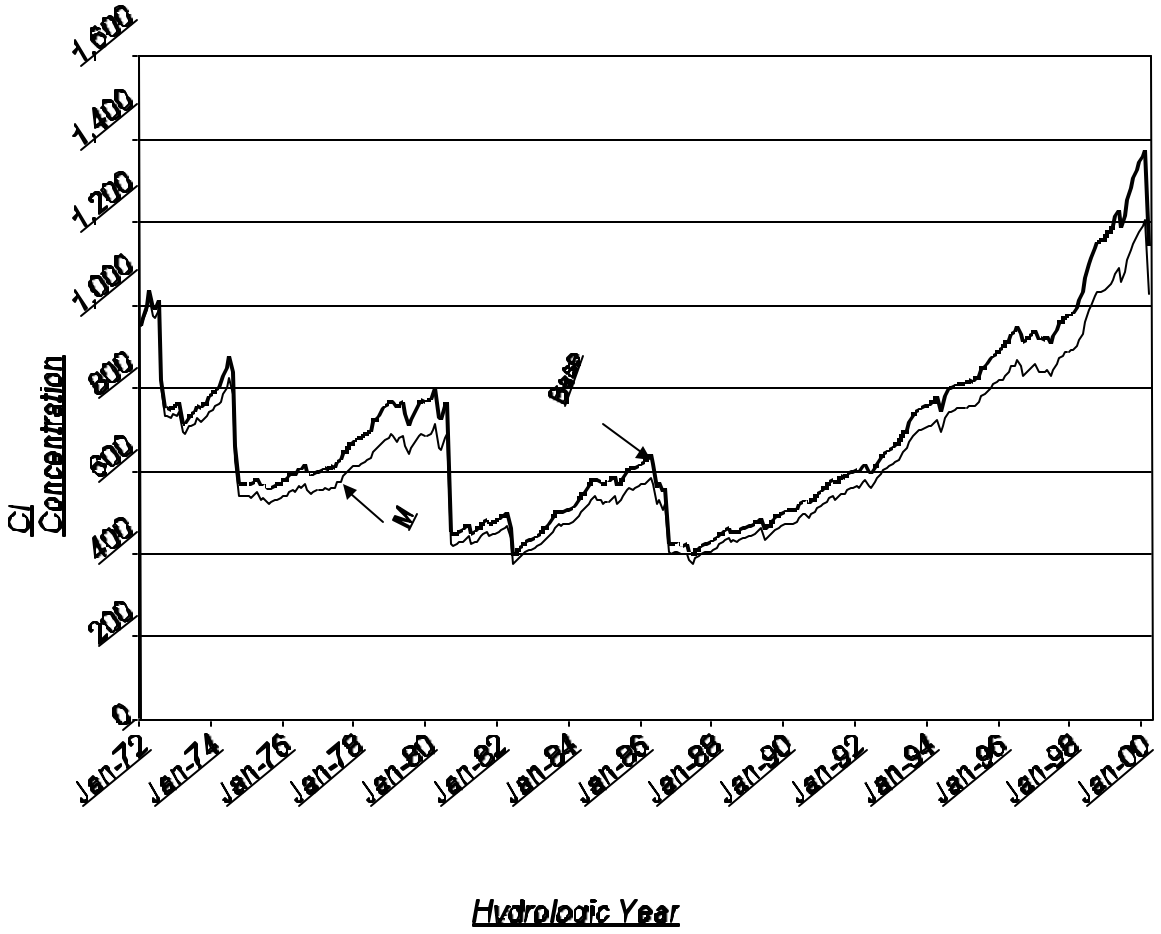

Figure 12. E.V. Spence Concentration Variation with Brush Control

Schedule for Implementation - A Phased Approach

As shown in the TMDL technical analysis, approximately 90% of the pollutants in the watershed are derived from nonpoint sources. Although the types of nonpoint sources are known, there is very limited data available on the effectiveness of existing and/or potential management measures available to address the sources. Furthermore, there are also limited financial resources available among the stakeholders to address nonpoint sources. For these reasons, a phased approach has been selected for this implementation plan. A phased approach provides assurances in the implementation process by incorporating measures in time-steps so that monitoring data may be evaluated to verify expected load reductions and determine the effectiveness of best management practices. A TMDL under the phased approach establishes a schedule or timetable for the installation and evaluation of management measures, data collection, the assessment for water quality standards attainment, and, if needed, additional predictive modeling. If monitoring determines that the measures implemented under a phase are not sufficient to achieve water quality standards, then the next phase of management practices shall be implemented. The implementation of management measures for E.V. Spence Reservoir will be scheduled into three separate phases. Phase I of the implementation plan will begin upon adoption (2001) of this plan by the Commission. Phase II of the plan will commence after three years (2004) upon determination that Phase I BMPs have not effectively improved water quality sufficient to achieve water quality standards. Phase III will begin after eight years (2009) of implementation upon determination that Phase II BMPs have not effectively improved water quality sufficient to achieve water quality standards. Throughout the implementation process, general updates will be provided to the stakeholders in the basin on a biennial basis.

Table 4. Implementation Schedule

Entity	Activity	Schedule
Phase I		
RRC	Existing Well Plugging Program	Ongoing Follow-up monitoring begins in 2002 Project ends 8/2002
CRMWD	Weather Modification	Ongoing Permit expires 12/2004
	Existing WQ Diversions	Ongoing
	Release Management	Measure initiated in 2002
	Diversion Management	Measure initiated in 2002
TNRCC	Triennial Standards Review	Initiated in 2003
TNRCC	Evaluation of Phase I Effectiveness	Initiated in 2003
Phase II		
TNRCC	Remediation of Magnesium Plant	TBD pending further assessment
TSSWCB	Targeted Brush Control	Funding Requested in 2001 Measure initiated in 2004
CRMWD	New WQ Diversions	Funding Requested in 2002 Measure initiated in 2004
	Weather Modification	Continuing
	Existing WQ Diversions	Continuing
	Release Management	Continuing
	Diversion Management	Continuing
RRC	New RRC Well Plugging Program	Funding Requested in 2002 Measure initiated in 2004
TNRCC	Evaluation of Phase II Effectiveness	Initiated in 2008
Phase III		
TNRCC	Re-evaluation of TMDL Load Allocation	Basin Management Cycle assessment of the Colorado River Basin occurs in FY2009

Water Quality Standards Assessment

The designated uses for E. V. Spence Reservoir are high aquatic life, contact recreation, and public water supply. For surface water bodies designated as sources of drinking water, standards for chloride, sulfate, and TDS are primarily related to costs of treatment, aesthetic qualities, and public acceptance of drinking water. These standards are referenced in the Texas Surface Water Quality Standards (TSWQS) as secondary constituent levels.

The specific standards that have been adopted by the state for E.V. Spence Reservoir have changed over time. When the reservoir was constructed, the criteria for chloride, sulfate, and TDS were set statewide at 500, 500, and 1,500 mg/L, respectively. In 1988, segment-specific standards were established for E.V. Spence Reservoir. The chloride standard was raised to 950 mg/L, the sulfate standard was lowered to the current level of 450 mg/L, and the TDS standard was unchanged.

There is a strong correlation between concentrations of different dissolved salts since parameters such as chloride and sulfate contribute to TDS. However, the current standards are not proportional to the normal composition of surface water received by E.V. Spence Reservoir. From January 1, 1972, to March 31, 2000, sulfate concentrations measured in the Colorado River near Silver have been approximately 70% of chloride concentrations, and TDS concentrations have been approximately 270% of chloride concentrations. The ratio of the current standards have sulfate concentrations at only 47% of chloride concentrations while TDS is only 157% of chloride concentrations. The result of this suite of standards is that water in E.V. Spence Reservoir is much more likely to violate the TDS and sulfate standards than the chloride standard.

To further investigate this situation, the TNRCC will assess the appropriateness of the water quality criteria for the E.V. Spence Reservoir. Water quality standards are publicly reviewed at least every three years in order to incorporate new information on potential pollutants and additional data about water quality conditions in specific waterbodies, and to address new state and federal regulatory requirements. The next triennial review will most likely occur in 2003 or 2004 pending EPA approval of the Texas Surface Water Quality Standards in 2001.

Legal Authority

In Texas, state statutory provisions require the commission to establish the level of quality to be maintained in, and to control the quality of, water in the state (Texas Water Code (TWC) §26.011). Texas fulfills its obligations under Section 303(d) of the Clean Water Act to list impaired segments and create TMDLs through functions assigned by the legislature to TNRCC. The 303(d) List is prepared by TNRCC as part of its monitoring, planning and assessment duties (TWC §26.0135).

TMDLs themselves are part of the state water quality management plans that TNRCC is charged by statute to prepare (TWC §26.036). As the state environmental regulatory body, the Commission has primary responsibility for implementation of water quality management functions within the State (TWC §§26.0136, 26.127). The Executive Director of the TNRCC must prepare and develop, and

the Commission must approve, a comprehensive plan for control of water quality in the state (TWC § 26.012). The list of impaired segments and resulting TMDLs are tools for water quality planning.

Procedures for implementing the Texas Surface Water Quality Standards are described in *Implementation of the Texas Natural Resource Conservation Commission Standards Via Permitting* (RG-194, August 1995).

Point Sources

Although the waste treatment facilities associated with the City of Snyder and the City of Big Spring were allocated their full-permitted load, the TNRCC has the legal authority if necessary at a future date to require reductions from those discharges. The TNRCC received delegation of the NPDES program from USEPA on September 14, 1998, and is authorized to implement the Texas Pollutant Discharge Elimination System (TPDES), the regulatory program to control discharges of pollutants to surface waters. The TPDES program covers all permitting, surveillance and inspection, public assistance, and enforcement regulatory processes associated with discharges of waste from industry and municipal treatment works.

Magnesium Plant

Under Title 30 TAC Chapter 335 Subchapter K, and Chapter 361 of the Texas Health and Safety Code, the TNRCC is authorized to seek remedies for uncontrolled releases of hazardous substances to the environment from abandoned hazardous waste sites. The Superfund cleanup section (SCS) has three teams which manage or provide management assistance to EPA with regard to the Superfund remediation process. The Superfund Site Discovery & Assessment Program identifies a site as being eligible for listing on either the state Superfund registry or the federal National Priorities List (NPL). The SCS ensures that all Superfund activities are completed in a timely and efficient manner, and in accordance with all applicable state and federal laws and rules.

Although the initial HRS preliminary ranking was found to be below 5, the site may still be a potential candidate for cleanup activities through the TNRCC Remediation Division. Priority will be assigned through coordination between the Remediation Division and the Strategic Assessment Division as further site assessment provides additional data.

Monitoring Strategy

A follow-up monitoring plan will be conducted within the E.V. Spence Reservoir's watershed throughout the implementation schedule. The monitoring strategy will consider the spatial and temporal aspects sufficient to characterize trends in water quality due to management practices included in the implementation plan and will provide water quality data for evaluation of standards attainment. The results of the water quality monitoring will be used to answer the following questions:

- Have TDS and sulfate concentrations declined to levels so that the reservoir no longer exceeds applicable Texas Surface Water Quality Standards?

- Are current management measures effective or is a new phase of BMP implementation necessary to address continued water quality standards exceedances?

- Are there any changes in model assumptions that have been identified that must be addressed through adjustments to the loading allocation or implementation plan?

- Are additional sampling efforts needed to further delineate potential source(s), and/or to continue monitoring where constituent levels have not yet reached the endpoint target?

The Clean Rivers Program was established to monitor and assess water quality conditions to support management decisions necessary to maintain and improve the quality of the state's water resources. The TNRCC coordinates regional monitoring and assessments of water quality by watershed and river basin with partners such as river authorities and designated local governments that have entered into cooperative agreements with the TNRCC. The Colorado River Municipal Water District participates in the Clean Rivers Program through a contract with the Lower Colorado River Authority, an established partner in the Clean Rivers Program.

According to 30 TAC Chapter 220, Clean Rivers Program partners are required to develop and maintain a basin-wide water quality monitoring program that eliminates duplicative monitoring, facilitates the assessment process to identify problem areas and support long-term trend analyses, and targets monitoring to support the wastewater discharge permitting and standards process.

To take advantage of the existing monitoring efforts through the Texas Clean Rivers Program, the monitoring strategy will include the current monitoring program conducted by the CRMWD. Through the CRP, the CRMWD will continue to monitor sulfate, TDS, and chloride at 10 stream stations above E. V. Spence Reservoir on a monthly basis and 3 reservoir stations at E. V. Spence on a biannual basis (See Appendix). The TNRCC will be coordinating with the CRMWD to ensure that the monitoring effort is sufficient and may reevaluate the location of stations and the monitoring frequency based on the results produced during each phase of implementation.

Reasonable Assurances

Implementation of voluntary management measures will only occur if reasonable assurances are provided that funds will be available and cooperating agencies and entities will be involved.

Weather Modification

To date, the TNRCC has been the State agency responsible for administering the Texas Weather Modification Act, enacted in 1967 by the Texas Legislature and now codified as Chapter 18 of the Texas Water Code. The Act required the agency to regulate the use of cloud seeding through a licensing and permitting procedure. Furthermore, the Act charged the TNRCC with promoting the development, and demonstration, of cloud-seeding technology through research. The agency promulgated rules to regulate weather modification in 30 TAC Chapter 289.

The 75th Texas Legislature gave the TNRCC funds to reimburse political subdivisions for costs incurred in conducting cloud seeding operations and the agency has been a substantial source of State funding for newly-designed and implemented weather-modification projects. State funds are available to cover the costs of both continuing and new cloud-seeding projects through the summer of 2001. The 77th Texas Legislature, through Senate Bill 1175, transferred authority for the regulation of weather modification to the Texas Department of Licensing and Regulation (TDLR).

The CRMWD has requested and obtained a weather modification permit from the TNRCC to conduct cloud-seeding operations in the E.V. Spence Reservoir watershed. The TNRCC issued the current weather modification permit to CRMWD in January 2000, and the permit will expire in December 2004. The TNRCC has an ongoing interlocal grant agreement with CRMWD which was initiated in 1997 to fund the weather modification program. Under this agreement, the CRMWD contributes 50% of the costs to implement the program. The agreement expires in 2001, and continuation of the program will reside with the TDLR.

Well Plugging

Under Texas Natural Resources Code Title 3, and Texas Water Code Chapter 26, wastes resulting from activities associated with the exploration, development, or production of oil or gas or geothermal resources are under the jurisdiction of the Railroad Commission of Texas. The RRC has established rules in Title 16 of the Texas Administrative Code (TAC) Chapter 3 which state that no person conducting activities subject to regulation by the RRC may cause or allow pollution of surface or subsurface water in the state. The TNRCC and the RRC have agreed to cooperate with one another in the pursuit of enforcement actions against responsible parties as stated in their Memorandum of Understanding in 16 TAC §3.30.

The TNRCC has an interlocal grant agreement with the RRC which was initiated in 1999 to fund the Upper Colorado River Salt-Water Minimization Project. The agreement will expire in August 2002. As of November 30, 2000, a total of 76 wells have been approved for plugging and 45 wells have been plugged since the beginning of this project. A portion of the resources included within the grant agreement is provided by the USEPA. The new well plugging project will be funded through the use of additional NPS funds from Section 319 of the Clean Water Act. The NPS Program has identified implementation of management actions in the E.V. Spence Reservoir from 2002-2015 as an objective in meeting NPS Program short-term goals (TNRCC, 1999).

Brush Control

The Texas State Soil and Water Conservation Board is the state agency with the primary responsibility for activities relating to agricultural and silvicultural nonpoint source (NPS) pollution abatement as defined by Senate Bill (SB) 503, Texas 73rd State Legislature. The TSSWCB represents the State before the United States Environmental Protection Agency (EPA), or other federal agencies on matters relating to agricultural and silvicultural nonpoint source pollution abatement. Consistent with the intent of Federal Clean Water Act, §319, the TSSWCB and the TNRCC are committed to the development and implementation of a coordinated NPS pollution program for the State as outlined in their Memorandum of Understanding in 30 TAC §7.102.

The TSSWCB has requested additional funding from the Texas Legislature in the amount of $258,426 to initiate a water quality management plan program for the E.V. Spence Reservoir watershed to implement the TMDL's brush control recommendations. The TSSWCB has also requested additional funding from the Texas Legislature in the amount of $6,734,739 to initiate a brush control program in the O.H. Ivie Reservoir watershed, which includes the E.V. Spence Reservoir watershed. If this funding is not awarded, the TSSWCB will pursue other sources of funding to assist the implementation of the recommended brush control.

Water Quality Diversions and Reservoir Management

An Act of the 51st Legislature of Texas in 1949, Article 16 Section 59 of the Constitution of Texas established the Colorado River Municipal Water District and conferred its power and authority. According to the statute, the CRMWD is constituted and declared to be a water control and improvement district and as such may provide for the control, storage, preservation, and distribution of its water and floodwater and the water of its rivers and streams as well as provide for the protection, preservation, and restoration of the purity and sanitary condition of the water. CRMWD was issued a certificate of adjudication on August 19, 1977, recognizing a water right in the Upper Colorado River Basin including E.V. Spence Reservoir.

As a participant of the Clean Rivers Program, the CRMWD is not only tasked to maintain a basin-wide water quality monitoring program, but also to identify water quality problems and known pollution sources and set priorities for taking appropriate actions to eliminate those problems and sources. Additionally, as a member of the E.V. Spence TMDL Steering Committee, the CRMWD approved the Watershed Action Plan (WAP) prepared by the CRMWD and their subcontractor, Freese and Nichols, Inc. These roles set CRMWD as the appropriate agency with the authority and purpose to implement the water quality diversions and reservoir management measures.

Measurable Outcomes

Verification that designated uses have been restored requires the measurement of applicable indicators to determine measures of success. Indicators generally fall into two major categories: programmatic indicators and environmental indicators. Environmental indicators can be subdivided into measures of environmental stressors or pollutants and measures of biological, ecological and human states of health. Programmatic and environmental monitoring activities represent important aspects of TMDL implementation, and both types of monitoring will be critical to assessing the implementation and effectiveness of activities that result in water quality improvements.

The measurable outcome of Phase I shall be the successful completion of the Upper Colorado River Salt-Water Minimization Project. Upon completion of the project, 171 abandoned oil and gas wells will be plugged and up to eight salt-water seeps in the watershed will be assessed and potentially remediated. This is a programmatic indicator that will be measured by the completion and submission of a final report deliverable that is required in the contract by August of 2002. An update on the measurable outcomes of Phase I will be provided to stakeholders in the basin.

The measurable outcome of Phase II shall be the attainment of water quality standards for sulfate and TDS within the E.V. Spence Reservoir. The monitoring strategy contained within this implementation plan shall provide for biannual monitoring in E.V. Spence Reservoir at three separate monitoring stations. This is an environmental indicator that will be measured through the analysis of pollutant data collected through the Clean Rivers Program. An update on the measurable outcomes of Phase II will be provided to stakeholders in the basin.

The measurable outcome of Phase III shall be the reevaluation of the TMDL technical analysis. The implementation plan will be revisited after eight years to evaluate the plan and if it is determined that the water quality standards have not been met, the plan will incorporate further changes. This is a programmatic indicator that will measure the effectiveness of the TMDL activities accomplished in the first two phases.

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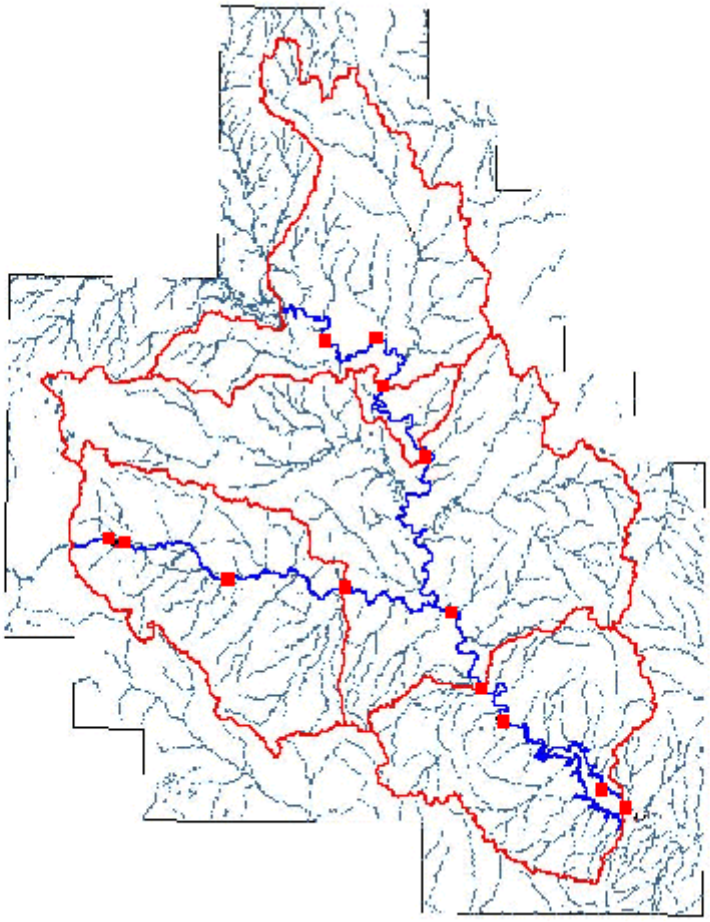
APPENDIX A



Current Monitoring Stations in E.V. Spence Reservoir Watershed

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