Texas Commission on Environmental Quality
Colorado River Below E. V. Spence Reservoir Watershed Protection Plan, Segment 1426

July 2013

Purpose

This document serves as a "bridge" document for the U.S. EPA Nonpoint Source (NPS) Program. Guidance for the NPS program requires EPA acceptance of a watershed-based plan before "project" funds can be used to implement BMPs. TCEQ believes TMDL documents generally satisfy many of the criteria specified by EPA for their acceptance of watershed-based plans. However, this information may be contained in multiple documents and may not be in a format that facilitates understanding the relationship with the 9-element criteria for watershed-based plans. Therefore, this document is provided to highlight the linkages between the TMDL and other documents prepared for the Colorado River below E.V. Spence Reservoir TMDLs and the EPA 9-element criteria for watershed-based plans.

Overview

Colorado River below E.V. Spence Reservoir is a freshwater stream that flows southeasterly through Coke and Runnels Counties in west central Texas. It is approximately 66 miles long and has a watershed greater than 2,000 square miles. The watershed lies in a transitional area between the live oak savannas of central Texas and the arid west Texas desert. It is flat to gently rolling plateaus dissected by canyons. Streams are mostly ephemeral or intermittent. Dominant land uses for this area are agricultural and rangeland. Oil and gas production and exploration are the dominant industrial activities in the watershed. The geology of this West Texas region is composed of Permian-age carbonates, evaporates, shales, mudstones, sandstones, and conglomerates. The groundwater within the area are undifferentiated aquifers of the Edwards-Trinity system that provide fresh to slightly saline groundwater for agricultural, domestic, and municipal uses. A map of the watershed illustrating its location is provided in Figure B1.

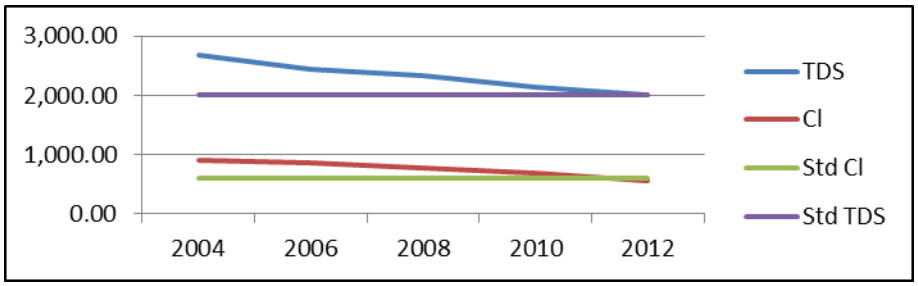
Figure B1. Project Location Map

Water Quality Assessment

General water quality uses in Segment 1426 were first identified as impaired in the *Texas Water Quality Inventory and 303(d) List* for 2000. Total Maximum Daily Loads (TMDLs) and an implementation plan for chlorides and total dissolved solids (TDS) were adopted by the Texas Commission on Environmental Quality (TCEQ) in January and October of 2007 respectively. The Segment 1426 TMDL documents outline a series of actions aimed at improving water quality in the watershed. The goal of the TMDL is to reduce levels of pollutants in Segment 1426 to levels that meet state water quality standards and restore the general uses of the water body. To achieve these goals, the TMDL documents prescribe implementing Best Management Practices (BMPs), monitoring the effectiveness of these initiatives, and communicating the results of these actions to watershed stakeholders.

Recent water quality assessments of Segment 1426 by the TCEQ shows improving water quality conditions. State water quality assessment data shows that concentrations of chloride have fallen below the established criteria. Therefore, chloride was removed as an impairment in the water body in the 2012 state water quality assessment. These same water quality assessments show TDS concentrations have fallen continuously since 2004 and are now just barely above the established criteria. The segment remains listed in the 2012 assessment (IR, 2012: Water Body Assessments, Segment 1426). Figure B2 below illustrates the most recent state water quality assessments for Segment 1426.

Figure B2. Water Quality Assessments and Standards for Segment 1426 (mg/l)



Drought conditions have been the dominant factor in evaluating water quality in this area of the state since 2011. Generally, rainfall in this area of the state has been about 50% of normal since 2011. Reservoirs are at historically low levels. E. V. Spence reservoir is at 5% of capacity. Water level in the reservoir is well below the discharge structure, meaning there is no discharge from E. V. Spence Reservoir to the Colorado River downstream. The drought in 2011 became the second worst drought on record, surpassing the drought from 1916 to 1919. These persistent drought conditions can impact water quality directly. Reduced flows can increase water temperatures and dissolved solids and decrease dissolved oxygen levels, which can negatively impact aquatic life. Figure B3 is of E. V. Spence Reservoir in February of 2012 illustrating the low water levels in the reservoir and extent of the drought.

Figure B3, E. V. Spence Reservoir, February 2012

Public Outreach

The water quality goals for Segment 1426 are supported by an active local stakeholder group. The Upper Colorado River Authority (UCRA) is coordinating watershed activities and involving the public in watershed management efforts. The stakeholder group represented by a variety of

different sectors, including industries, interest groups, universities, water districts, cities, and federal and regional government organizations.

References

TMDL Documents

TMDL Report (TMDL): *Two Total Maximum Daily Loads for Chloride and Total Dissolved Solids in the Colorado River Below E.V. Spence Reservoir*, Texas Commission on Environmental Quality, February 7, 2007

TMDL Implementation Plan (I-Plan): *Implementation Plan for Two Total Maximum Daily Loads for Chloride and Total Dissolved Solids in the Colorado River Below E.V. Spence*, Texas Commission on Environmental Quality, October 10, 2007

TMDL Technical Support Document (TSD): *Colorado River below E. V. Spence Reservoir (Segment 1426) Total Maximum Daily Load for Chloride and Total Dissolved Solids*, Report Number: TX1426-10-2004, EA Engineering and Louis Berger Group, May 2006

Proposed 319 Project(s)

Mitigation of Produced Water Contamination into the Colorado River Segment 1426 Downstream of E.V. Spence Reservoir near Ballinger (FY 2013, Ballinger)

Mitigation of Produced Water Contamination into the Colorado River Segment 1426 at the Wendkirk Oilfield (FY 2013, Wendkirk)

Texas Integrated Report for 2012 (IR, 2012)

http://www.tceq.texas.gov/waterquality/assessment/waterquality/assessment/12twqi/twqi12

Texas Clean Rivers Program, Coordinated Monitoring Schedule (CRP, 2014)

https://cms.lcra.org/schedule.aspx?basin=14&FY=2014

TSSWCB Reports

Targeted Brush Control in the E.V. Spence Reservoir Watershed Final Report
TSSWCB Projects 03-06 and 00-1, (TSSWCB, 03-06)

Upper Colorado Saltcedar Control Project: Biological Control Component, Final Report
TSSWCB Project # 03-11 (TSSWCB, 03-11)

Railroad Commission of Texas Reports

Runnels County Saltwater Minimization Project, Final Report, FY 2002 Section 319 Grant Project 01 (RRC, 2002).

Investigations and Abatement of Produced Water Impacts and Seeps to Surface Water Downstream of Spence Reservoir (Segment 1426) Coke and Runnels Counties, Texas, Final Report, September 2008 (RRC, 2008)

Element A – Causes and Sources of Water Quality Issues

An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed based plan (and to achieve any other watershed goals identified in the watershed based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded stream-bank needing remediation).

Source Identification

Salinity in Segment 1426 likely results from natural geologic conditions, oil and gas production, and salt cedar as described in the TMDL documents. Geologic formations in the watershed are naturally high in chloride, sulfate, and carbonate salts. Oil and gas production is identified the major source of man-made salinity and a cause of water quality impairment in the watershed. (TSD: pgs 2-12)

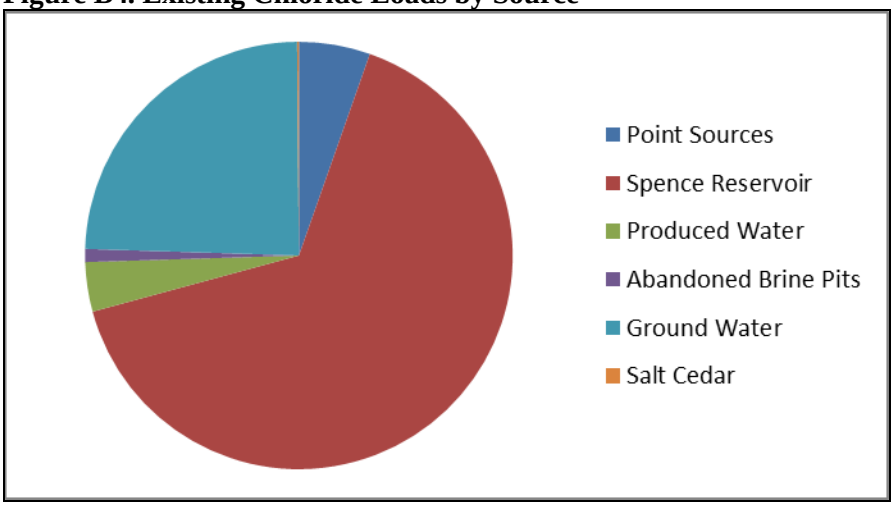
The HSPF model was used by the TMDL project as a tool to predict the in-stream water quality conditions of the Colorado River. The watershed was delineated into 32 smaller sub-watersheds to represent watershed characteristics. Both the hydrologic and water quality components of the HSPF model were calibrated and verified. (TSD: Sec 4.7.2 to 4.7.6; pgs 4-9 and 4-10)

The existing chloride and TDS loadings to the receiving water were calculated based on watershed conditions and using the model simulations output during the period of 1996 to 2004. This information is summarized in Table B1 and Figure B4 below. (TSD: Tbls 4-7 and 5-2; Figs 4-20 and 4-21)

Table B1. TDS and Chloride Existing Load Distributions by Source

Source	Chloride (Lbs/Year X 10^6)	Total (%)	TDS (Lbs/Year X 10^6)	Total (%)
Point Sources	2.06	5.4	5.80	5.4
Nonpoint Sources				
Spence Reservoir	25.0	65.4	70.0	65.4
Produced Water	1.43	3.7	4.01	3.7
Abandoned brine pits	0.377	1.0	1.03	1.0
Groundwater	9.32	24.4	26.1	24.4
Salt Cedar	0.05	0.1	0.13	0.1
Total	38.2	100	108.	100

Figure B4. Existing Chloride Loads by Source



As can be observed in Table B1 and Figure B3, the upstream boundary (i.e., discharge from E. V. Spence Reservoir) is the predominant source of chloride and TDS to the river downstream. Groundwater, produced water, abandoned brine pits, and salt cedar are also identified as significant sources of the pollutants of concern to the water body. Sources of salinity contributing to the impairment are discussed further below.

Point Sources

Five permitted wastewater dischargers are located within Segment 1426. Point source loads considered in the model were included in the overall TMDL calculations. Point sources were assumed to have average concentration values of 50 mg/L chlorides and 105 mg/L TDS. (TSD: Sec 4.7.1, pgs 4-8 to 4-9; TMDL: pg 15)

Nonpoint Sources

Spence Reservoir

E.V. Spence Reservoir is located directly upstream of the impaired segment. This reservoir boundary condition was simulated using flow data from USGS gauge 08124000 and average monthly chloride, sulfate, and TDS concentrations collected at water quality monitoring station 15147. The average monthly concentrations were derived from the time-series of observed water quality data at station 15147. (TSD: Sec 4.7.6, pg 4-10)

Produced water

Loading from the produced water was determined from groundwater water quality data, surface water quality data, and locations of known oil field operations and wells in the

watershed. The load estimates from produced water were then developed using the lowest groundwater well concentrations for chlorides. These lowest observed concentrations imply the absence of loads from produced water. The load component from the produce water wells was developed by subtracting the simulated groundwater water loads without the produced water from the overall simulated groundwater loads. (TSD: Sec 4.7.2, pg 4-9)

Abandoned Brine Pits

Abandoned brine pit loading was simulated as a NPS with a fixed build-up rate. Abandoned brine pits are simulated as a land use category within the HSPF model. Loading from the abandoned brine pits was determined from groundwater and surface water quality data, the locations of known oil field operations and wells in the watershed and by calibrating the model during wet weather events and then subtracting the load associated with the phreatophytic bush from the total load associated with surface runoff. (TSD: 4.7.5, pg 4-10)

Ground Water

Natural salt loads can be derived from natural geologic formations. Salinity loads from these formations were determined from groundwater well data. The average groundwater concentrations, reflecting the presence of these natural loads such as gypsum, were estimated as 156 mg/L chloride and 355 mg/L sulfate.

The production of oil and gas in the Colorado River Basin has resulted in widespread Contamination of shallow ground-water resources by saline waters. Many abandoned wells typically have cracks and leaks, which may eventually allow brines to reach the surface, potentially contaminating ground water and surface water. (TSD: Sec 4.7.3, pg 4-9)

Salt Cedar

Salt cedar (Tamarix spp.), a type of phreatophytic bush, is a non-native invasive plant known to out-compete native vegetation, elevate soil salinity by depositing salt secreted during transpiration, and consume large quantities of groundwater. The average salt cedar density along stream banks of the Colorado River was estimated at 23,376 plants per acre (Hays 2003). It was also assumed that one tree can consume over 75 gallons of water a day (Land and Water 2003) and can produce roughly 41,000 ppm of salt annually (Wisenborn 1996). (TSD: Sect 4.7.4, pg 4-9)

Location of Sources

The location of sources of salinity to the Colorado River has been the subject of numerous studies and investigations. The locations of point sources are known through TCEQ permit records. The location of the upstream boundary and discharge from E. V. Spence Reservoir is known. Assumptions were made about the distribution of salt cedar in the watershed for modeling purposes. For this study, salt cedar was estimated to be present within a 100-foot buffer on the main-stem Colorado River and within a 50-foot buffer on its tributaries. The location of oil field activity is known through RRC permits and records.

In-stream water quality surveys of the Colorado River from 1996 to 2004 were evaluated to help characterize and locate sources of salinity. The analysis of the water quality data consisted of developing constituent concentration frequency distributions for four stations along the main-stem of the Colorado River. All four stations showed similar frequency distribution trends for chlorides and TDS. The results of the analysis indicate that chloride levels fluctuate within the segment downstream of E.V. Spence Reservoir. (TSD: Sec 4.9, pgs 4-14 to 4-18)

Field monitoring surveys of Colorado River were conducted by the TMDL project team from January 2003 through September 2004 to further investigate the location of pollution sources. These field investigations collected data on the hydrology, water quality, and geology of Segment 1426. The goal of the field investigation was to quantify and document the presence of pollutants and associated factors in Segment 1426. The study also focused on characterizing the geology of Segment 1426 and the interrelationship between geology and groundwater.

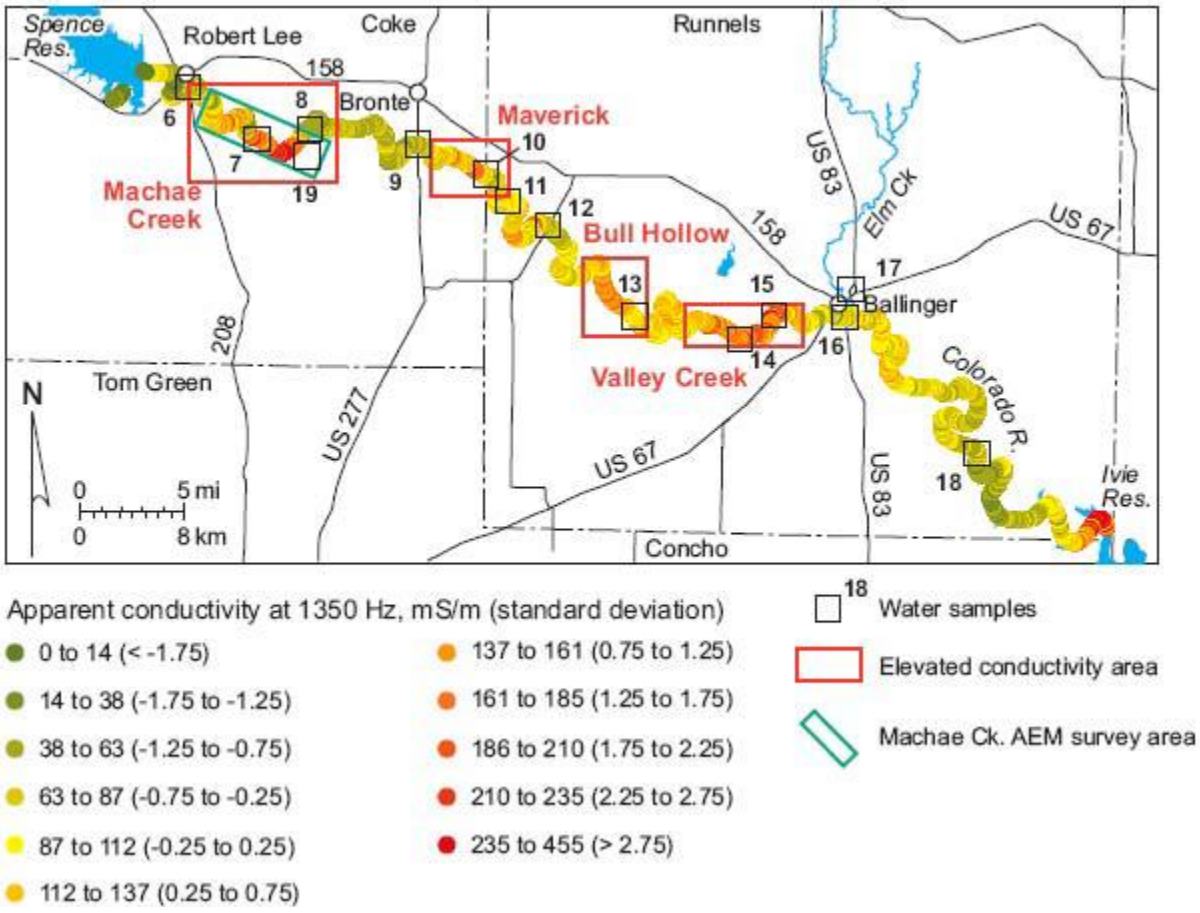
In order to better define the sources of chloride and TDS in Segment 1426, the University of Texas' Bureau of Economic Geology (BEG) conducted ground and airborne geophysical surveys using a multi-frequency electromagnetic induction (EM) instrument to delineate the extent and intensity of salinity that degrade surface-water quality in the upper Colorado River.

In the ground surveys, the BEG used a ground conductivity meter to take conductivity measurements at 344 locations along the river. The instrument operates to a depth of about 3 meters and measurements were taken in both with a horizontal the vertical orientations.

Aerial conductivity measurements were acquired in early February 2005 along closely spaced flight lines within two blocks measuring 1.8 x 6.2 miles (mi), centered on the Colorado River near Robert Lee and Silver. The stream-axis airborne survey flew over 89 miles of the Colorado River downstream from E.V. Spence Reservoir.

The results of the EM surveys indicated apparent conductivity trends plotted from river-axis data allow delineation of four areas of where ground conductivity appears generally elevated along Segment 1426 (Figure B5). From upstream to downstream, these include the Machae Creek area near Robert Lee, the Maverick area near Bronte, the Bull Hollow area below FM 3115, and the Valley Creek area between FM 2111 and Ballinger. The projects proposed in the FY 2013 Section 319 grant application are located in the Machae Creek and Valley Creek areas of the watershed. These areas represent the stream reaches most likely to be contributing highly saline water that degrades Segment 1426 water quality. (TSD: Sec 3.7.3, pgs 3-23; TMDL: pgs 18 to 24).

Figure B5. Colorado River Below E.V. Spence, Areas of Elevated Conductivity



References to other technical information used to support the analysis of sources of salinity in the Colorado River watershed are summarized below in Table B2.

Table B2. References to Other Technical Information, Element A

Data Type	How Does Data Type Support Element A?	Reference
Climatic, economic, and geographical conditions and information	Documentation of data used to support the model.	Section 2.2 on pages 2-2 through 2-10 of the Technical Support Document.
Physiographic, hydrographic, weather, pollutant sources, point sources, environmental monitoring, and stream data	Documentation of data used to support the model.	Table 3-1 on page 3-1 of the Technical Support Document.
Stream flow and rainfall data	Documentation of data used to support the model.	Section 3.3 on page 3-7 of the Technical Support Document and pages 10 through 13 of the TMDL
Monitoring station identification, station locations, period of record, data range, exceedances, and time series	Documentation of data used to support the model.	Section 3.2 on pages 3-2 through 3-6 of the Technical Support Document and pages 9 through 13 of the TMDL
Field monitoring surveys conducted by the TMDL project collected data on hydrology, water quality, and geology	Documentation of data used to support the model.	Section 3.7.2 on pages 3-13 and 3-14 of the Technical Support Document and pages 17 and 18 of the TMDL
Watershed boundaries, land use reclassification, pollutant source representation, model setup, model calibration and verification, and modeling results	Documentation of data used to support the model.	Section 4 on pages 4-1 through 4-25 of the Technical Support Document
Model set-up	Documentation of modeling exercises.	Section 4.8.1 on pages 4-11 and 4-12 of the Technical Support Document
Model hydrologic calibration	Documentation of modeling exercises.	Section 4.8.2 and 4.8.3 on pages 4-12 and 4-13 of the Technical Support
Calibration of the water quality component of the model	Documentation of modeling exercises.	Section 4.9.2 on pages 4-20 through 4-25 of the Technical Support Document
Land Use data	Documentation of data used to support the model.	TSD: Sec 2.3, pgs 2-11

Oil and gas production data	Documentation of data used to support the model.	TSD: Sec 2.4, pgs 2-12 and 2-13

Element B – Load Reduction Expected from Identified Solutions

An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for row crops; eroded streambanks, etc.).

Pollutant load allocations were evaluated from the results of watershed and water quality modeling scenarios that met state water quality standards. Identified solutions are the proposed CWA 319 FY13 RRC projects for implementing BMPs to further reduce pollutant loadings to Segment 1426.

Load Allocation

Allocation scenarios that would reduce the existing chloride and TDS loads necessary to meet the corresponding water quality standards were simulated using the HSPF model. The reductions of loading from nonpoint sources, including abandoned brine pits, produced water, groundwater, and the upstream boundaries (Spence Reservoir) are incorporated into the load allocation. A number of load allocation scenarios were considered to identify the final TMDL load allocations.

For the hydrologic period spanning from January 2000 to December 2004, the chloride and TDS simulated concentrations were compared against the corresponding standards to estimate the number and frequency of exceedances. Running averages of chloride and TDS concentrations over consecutive 365 days were calculated for direct comparison with the water quality standards. Water quality exceedances occur when the 365-day running average exceeds the standard. The results of the comparison for all the scenarios were evaluated.

Simulated chloride and TDS concentrations under the existing condition show 100 percent and 70.1 percent exceedance of the water quality standards, respectively. Scenario 7 was selected as the TMDL scenario because it showed no exceedance of chloride and TDS water quality standards. Modeling results demonstrated that a maximum chloride concentration of 550 mg/L and a TDS concentration of 1537 mg/L in the release water from E. V. Spence Reservoir would attain the water quality standards. These concentrations and the observed flow were used in the derivation of the TMDL load allocations (Scenario 7).. The modeling showed more than one allocation scenario meeting the water quality standard. A summary of the Scenario 7 allocation loads to the receiving water for chloride and TDS is presented in Table B3. (TSD: Sec 5.3, pgs 5-6 through 5-8, Tbl 5-5; TMDL: pg 33, Tbl 11)

Table B3.Scenario 7. Allocations for TDS and Chloride by Source

Source	Annual Average Loads (lbs/Year X 10^6)			
	Chlorides	Total (%)	TDS	Total (%)
Spence Reservoir	0.560	4.5	1.57	4.5
Produced Water	1.27	10.1	3.55	10.1
Abandoned Brine Pits	3.61	2.9	1.01	2.9
Groundwater	8.26	65.7	23.1	65.7
Salt Cedar	0.0429	0.3	0.120	0.3
Point Sources	2.08	16.5	5.80	16.5
Total	**12.6**	**100**	**35.1**	**100**

Load Reductions

Based upon the selected TMDL allocation scenario, the pollutant load reductions needed to meet water quality standards are shown below in Table B4. The load reductions are calculated by subtracting the allowable loading determined from the TMDL Scenario 7 from the existing loadings estimated from the HSPF modeling.

Table B4. TDS and Chloride Load Reductions by Source

Source	Chlorides (lb/yrX10^6)				TDS (lb/yrX10^6)			
	Existing	TMDL	Ld Red	Reduction (%)	Existing	TMDL	Ld Red	Reduction (%)
Spence Reservoir	**25.0**	**0.56**	**24.44**	**97.8**	**70.0**	**1.57**	**68.43**	**97.8**
Produced Water	**1.43**	**1.27**	**0.16**	**11.1**	**4.01**	**3.55**	**0.46**	**11.5**
Abandoned Brine Pits	**0.38**	**0.36**	**0.02**	**4.2**	**1.03**	**1.01**	**0.02**	**2**
Groundwater	**9.32**	**8.26**	**1.06**	**11.4**	**26.1**	**23.1**	**3.0**	**11.5**
Salt Cedar	**0.05**	**0.04**	**0.01**	**14.2**	**0.13**	**0.12**	**0.01**	**7.7**
Point Sources	**2.08**	**2.08**	**0**	**0**	**5.80**	**5.80**	**0**	**0**
Total	**38.257**	**12.6**	**25.66**	**67.1**	**107.07**	**35.1**	**72.6**	**67.8**

Identified Solutions

The RRC has submitted two applications for EPA Section 319 grant funding for the FY 2013 grant cycle to implement management measures specified in the TMDL documents to address

the water quality impairments in Segment 1426. These applications propose water quality remediation projects to address groundwater discharges at abandoned oil and gas production fields in the watershed. These projects are designed to mitigate salinity in the Colorado River by intercepting and removing highly saline contaminated groundwater from the sub-surface before it contaminates the river. The RRC proposes remedial actions at both the Ballinger and Wendkirk oil field sites (see Figure B1, the Ballinger site is near the town of Ballinger and the Wendkirk site is located with the Machae Creek area).

At the Ballinger site, the RRC proposes to install a recovery trench and extraction wells to remove contaminated ground water. The contaminated ground water will be disposed at an approved off-site disposal location. The RRC anticipates a total reduction in potential chloride loading of approximately 175,000 pounds/yr with corresponding decreases in sulfate and TDS levels (FY 2013, Ballinger, Part XIII, #37).

At the Wendkirk site, the RRC proposes to install 6 to 10 extraction wells to remove contaminated ground water. The contaminated ground water will be disposed at an approved off-site disposal location. The RRC anticipates a total reduction in potential chloride loading of approximately 550,000 pounds/yr with corresponding decreases in sulfate and TDS levels (FY 2013, Wendkirk, Part XIII, #37).

The combined load reduction from the two projects is about 725,000 lb/yr or about 68% of the load reduction goal for the "Groundwater" source category and about 3% of the load reduction goal for all source categories.

References to other technical information used to support the analysis of sources of salinity in the Colorado River watershed are summarized below in Table B5.

Table B5. References to Other Technical Information, Element B

Data Type	Reference
Process used to develop the load allocations for the TMDL	*Section 5* on pages 5-1 through 5-6 of the Technical Support Document and pages 25 through 29 of the TMDL
Load allocation scenarios considered during the development of the TMDL	*Section 5.2* on pages 5-2 through 5-6 of the Technical Support Document and pages 29 through 31 of the TMDL
Load allocation scenario selected for the final TMDL	*Section 5.3* on pages 5-6 through 5-8 of the Technical Support Document and pages 31 through 33 of the TMDL

Element C – Management Measures to be Implemented

A description of the NPS management measures that will be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

TCEQ establishes implementation plans (I-Plans) for each TMDL in order to restore and maintain water quality in impaired rivers, lakes, and bays in the state. I-Plans describe the steps the TCEQ and its partners will take to achieve pollutant reductions identified in the TMDL report. The I-Plan for the Colorado River below E. V. Spence Reservoir TMDL is designed to guide activities that will reduce chloride and TDS in accordance with the adopted TMDLs. The ultimate goal of the I-Plan is to restore the general uses of Segment 1426 by reducing the average annual concentrations of chloride and TDS to levels that meet the criteria established in the state's water quality standards. TCEQ provides assurances that the implementation activities set forth in the I-Plan will be implemented in the Reasonable Assurances section of the I-Plan. (I-Plan: pgs 35 - 36). The management measures for each source of pollution presented in the I-Plan are briefly discussed below.

Oil Field Activities: Produced Water, Abandoned Brine Pits, and Groundwater Seeps

The RRC has initiated projects to investigate the nature and extent of known salinity contamination associated with oil and gas production, develop remediation/abatement alternatives or BMPs, and implement BMPs to specifically reduce the high salinity that contributes to water quality degradation. These projects achieve remediation of water quality conditions by addressing groundwater discharges at abandoned oil and gas production fields in the watershed. These projects are designed to mitigate salinity in the Colorado River by intercepting and removing highly saline contaminated groundwater from the sub-surface before it contaminates the river. BMPs are identified and evaluated for effectiveness for use in seeps into the Segment 1426 watershed associated with the Wendkirk and Ballinger oil fields. (I-Plan: pgs 9 - 12, Tbl 1)

Runnels County

The RRC completed the "Runnels County/Upper Colorado River Saltwater Discharge Minimization Project" in 2007. The project was successful in plugging 183 abandoned, improperly plugged, or unplugged oil and gas wells, and salt-water injection and/or disposal wells in Runnels County with the financial support of Section 319 grant funds. The wells are largely located in the watershed of Segment 1426. The project was able to address more wells than specified in the approved work plan. As the lead entity, the RRC selected wells in the Upper Colorado River Basin, specifically in the Runnels County area, from a pool of non-

compliant (abandoned and orphaned) and improperly plugged wells in the drainage basin. (RRC, 2002)

Wendkirk Oil Field Source Area

The Wendkirk Oilfield is located within the Machae Creek area downstream of the Machae Creek and Colorado River confluence and in the upstream portion of Segment 1426. The water associated with oilfield production (produced water) in the Wendkirk Oilfield is saline with high chloride (89,960 mg/L) and TDS (138,000 mg/L) levels. Oilfield activities can contribute to the localized loading of salt into the Colorado River and its tributaries by the release of produced water into the groundwater that may flow through natural permeable units, fractures or joints; upward movement of produced water across confining beds through improperly completed or improperly plugged oil and gas wells and deep unplugged water wells; and infiltration of produced water beneath surface pits. Pressurized brine within non-producing geologic units can also reach the surface through deep-water wells and improperly completed or plugged oil and gas wells. Contaminated groundwater can impact the Colorado River and its tributaries as base flow during gaining periods.

Assessment and Plugging of the Mays-01 Water Well - RRC staff completed a project in 2008, with funding from EPA's Section 319 NPS program, and RRC's Oil and Gas Regulation and Cleanup Fund. From this study, RRC staff concluded that groundwater is likely contributing elevated salinity into the Colorado River and identified the Mays-01 water well as a possible source of contamination. This project included plugging the water well and the engineering design of a saline water extraction system BMP. (RRC, 2008)

FY 2013 TCEQ NPS Grant Cycle, Wendkirk - The RRC proposes to install 6 to 10 extraction wells to remove contaminated ground water. The contaminated ground water will be disposed at an approved off-site disposal location. The RRC anticipates a total reduction in potential chloride loading of approximately 550,000 pounds/yr with corresponding decreases in sulfate and TDS levels. (FY 2013, Wendkirk: Part XII, #37)

Ballinger Oil Field Source Area

The Ballinger Seep site is located along the Colorado River approximately half a mile east and downstream of Ballinger, Runnels County, Texas. The RRC conducted investigations in to the extent and magnitude of the Ballinger Seep. The main source of saline water seepage was determined to be from an uncased cable tool well drilled in 1935 identified as the Wolverton Well No. 1. The Wolverton Well No. 1 was re-entered by the RRC and plugged in June of 2008. The RRC continues to sample the monitor wells, seeps, and the Colorado River to determine the effectiveness of the BMP. The cost for re-entering and plugging the Wolverton Well No. 1 totaled $70,975.

FY 2013 TCEQ NPS Grant Cycle, Ballinger - The RRC proposes specific remedial actions at the Ballinger oil field site which is located near the town of Ballinger (see Figure B1). The RRC proposes to install a recovery trench and extraction wells to remove contaminated ground water. The contaminated ground water will be disposed at an approved off-site disposal location. The

RRC anticipates a total reduction in potential chloride loading of approximately 175,000 pounds/yr with corresponding decreases in sulfate and TDS levels. (FY 2013, Ballinger: Part XIII, #37)

E.V. Spence Reservoir

Based on the TMDLs for Segment 1426, the I-Plan seeks to ensure that releases from E.V. Spence Reservoir are at or below 550 milligrams per liter (mg/L) of chloride and 1,537 mg/L of TDS in order to meet the criteria defined in the state's water quality standards.

The Colorado River Municipal Water District (CRMWD) is constituted with the authority for the control, storage, preservation, and distribution of its water as well as the protection, preservation, and restoration of the purity and sanitary condition of the water. CRMWD has the authority and purpose appropriate to implement the water quality diversions and reservoir management measures.

CRMWD operates a "diverted water" supply system to prevent highly mineralized surface water that occurs routinely under base-flow and low-flow conditions in the Colorado River and Beals Creek (a tributary to the Colorado River) from reaching E.V. Spence Reservoir. Poor quality surface water is captured and pumped to nearby storage reservoirs for evaporation. The less-saline water experienced during high- or flood-flow conditions is allowed to bypass the pumping station and travel downstream to E.V. Spence Reservoir. The TCEQ and the CRMWD have deployed monitoring stations in the Upper Colorado River watershed to assist CRMWD in diverting highly saline flows away from E.V. Spence Reservoir. (I-Plan: Control Action 3, pgs 12-13, Tbl 1)

These operations have been greatly impacted by the drought in recent years. The water level in E. V. Spence Reservoir is below the discharge structure, so there is no discharge from the reservoir to the Colorado River downstream.

The Upper Colorado River Authority (UCRA) was chartered by the State of Texas to protect the watershed of Tom Green, Coke and other contiguous counties. UCRA serves as a lending institution for local municipalities seeking to make area water improvements, participates in the Clean Rivers Program, EPA NPS abatement programs, Brush Control, Bank Stabilization, storm water management, rural water Supply, extensive public education and outreach efforts and various other special projects. Due to the success of these endeavors, the Upper Colorado River Authority has moved to the forefront as a leader in water quality and preservation in West Texas.

UCRA is an active partner with the Lower Colorado River Authority as a participant in the Clean Rivers Program. UCRA collect water quality data from stream segments within its jurisdiction. Through these activities, the UCRA has been successful in identifying specific water quality problems and solutions and obtaining funding assistance to address these needs.

Brush Control

The Texas State Soil and Water Conservation Board (TSSWCB) administers the Texas Brush Control Program for the selective control, removal, or reduction of noxious brush such as salt cedar or other phreatophytes that consume water to a degree that is detrimental to water conservation. The TSSWCB worked with local soil and water conservation districts and others, to implement a multi-year salt cedar control project to reduce salinity loadings in the region. These activities removed 11,391 acres. Most of the brush control work has been in the watershed of E. V. Spence Reservoir, upstream of Segment 1426. (I-Plan: Management Measure 1, pg 9, Tbl 1)

Element D – Technical and Financial Assistance Needed

An estimate of the amounts of technical and financial assistance needed, associated cost, and/or the sources and authorities that will be relied upon, to implement this plan. Expected sources of funding, States should consider Section 319 programs, State Revolving Funds, USDA's EQIP and CRP, and other relevant Federal, State, local and private funds to assist in implementing this plan.

Oil and Gas Operations

Management Measures: Well plugging, Groundwater interception and extraction

Technical Assistance: The RRC is the lead state agency for managing pollution from oil and gas exploration. RRC staff oversee technical work including site investigations, BMP selection, design, construction, operation and maintenance.

Financial Assistance:

Well Plugging - Runnels County, FY 2002 CWA §319 grant, $1,154,000
Well Plugging – Wendkirk, Ballinger, FY 2004 CWA §319 grant, $443,000
Interception/extraction - Wendkirk, Proposed FY 2013 CWA §319 grant, $510,665
Interception/extraction - Ballinger, Proposed FY 2013 CWA §319 grant, $520,316

The RRC has significant leveraging capability to cleanup abandoned oil and gas sites by using the Oil and Gas Regulation and Cleanup Fund (state-managed funds). In 1991, the Texas Legislature created the fund to give the RRC, on behalf of the state, the financial ability to plug abandoned oil and gas wells and to remediate abandoned oil and gas field sites across Texas. In addition to the RRC providing 40 percent of matching funds of grant total in the form of cash match from the state fund, the RRC has used state-managed funds to continue grant commitments for operation, maintenance, and monitoring activities after project completion in several federally funded projects. Specific examples of RRC ongoing project activity following the completion of the grant period for three EPA NPS Program CWA § 319(h) grants are summarized below:

West O'Daniel Seep - Operation and maintenance of saline water recovery interceptor trench and storage tank battery. Monitoring for BMP effectiveness.

Wolverton No. 1 Well, Ballinger Seep - Monitoring for effectiveness of well plugging, review of oil and gas records, and review of completion reports and analytical data for other sources.

Mays-01 Water Well, Wendkirk Oil Field - Monitoring for effectiveness of well plugging, review of oil and gas records, and review of completion reports and analytical data for other sources.

Salinity Investigation Along Petronila Creek - Five high saline source areas were identified. BMPs were designed and implemented at two source areas using RRC state-managed fund Assessment and remediation are currently ongoing.

Spence Reservoir Salt Control

Management Measures: Continuous monitoring, salt water diversions

Technical Assistance: CRMWD has the authority to implement the water quality diversions and reservoir management measures. UCRA is an active partner with the Lower Colorado River Authority as a participant in the Clean Rivers Program (CRP). UCRA collect water quality data from stream segments within its jurisdiction. Through these activities, the UCRA has been successful in identifying specific water quality problems and solutions and obtaining funding assistance to address these needs.

Financial Assistance:
Continuous monitoring - CWA §106 grant
Water quality monitoring - CRP

Brush Control

Management Measures: Phreatophytic brush removal

Technical Assistance: TSSWCB administers the Texas Brush Control Program for the selective control, removal, or reduction of noxious brush.

Financial Assistance:
TSSWCB, Salt Cedar Control, FY 2003 CWA §319 grant, $2,307,692

Element E – Education and Outreach Component

> *An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.*

The TMDL for Segment 1426 was developed with the support of an active stakeholder group. The stakeholder group consisted of water quality professionals, elected officials and their representatives, and other interested parties who provided resources, technical assistance, and expertise throughout the planning process. The TMDL documents were designed to give the flexibility necessary to make future amendments as conditions and opportunities warrant. The stakeholders' commitment to help prevent future degradation of water quality in the Colorado River is an integral part of the TMDL. (TMDL: pgs 34-35)

The TCEQ maintains an inclusive public participation process. From the inception of the investigation, the project team sought to ensure that stakeholders were informed and involved. The project team also recognized that communication and comments from stakeholders in the watershed would strengthen the project and its implementation plan.

A stakeholder committee was established and notices of meetings were posted. A project web page was established to provide meeting summaries, presentations, ground rules, and a list of stakeholder committee members. The website also ensured that absent stakeholders and the public were informed of meetings and other pertinent material.

Throughout the term of the TMDL project (2002 to 2006), seven meetings were held in Ballinger, in Runnels County. Based on interest and attendance, meetings were held in both the afternoon and evening. The objectives of the stakeholders meetings were to:

- Provide historical monitoring data, information, issues, and potential sources
- Provide information about the TMDL stakeholder process and about how interested parties could participate and influence the development of the TMDL.
- Provide information on the monitoring plan and monitoring schedule
- Provide information on the selected model, HSPF, and its process
- Provide information on the draft TMDL and load allocation

The TCEQ TMDL team is working with the Upper Colorado River Authority in an effort to develop a revisions document to the original Implementation Plan for the Colorado River below EV Spence reservoir (segment 1426). The message of this effort is the need to evaluate and revise the original I-Plan (2007) based on the current status of the watershed and what has been done so far to improve water quality.

This education and outreach effort is targeting the stakeholders within the watershed, by forming a coordination committee and work groups made up of representatives of local interest groups, as well as local experts in the different water quality issues and solutions being discussed. The committee has just completed its third meeting, and is working on developing the work groups. The different groups being represented on the committee include: municipal entities, industry, agriculture and ranchland, local government, community leaders, landowners, oil/gas, and water suppliers. The meetings have been open to the public and encourage participation from all community members in the watershed.

The RRC projects proposed for FY 2013 319 funding include provisions for outreach such as the preparation of explanatory materials, presentations at stakeholder meetings, and the maintenance of a project website. (FY 2013, Wendkirk, Task 5, pg 18) (FY 2013, Ballinger, Task 5, pg 17)

Element F – Implementation Schedule

A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

Schedules are established to reflect the nature of the work being performed. Schedules were established and completed in earlier projects. The schedule for current and ongoing project activities is specified below in Table B6. (I-Plan: pgs 8-13, Tbl 1) (FY 2013, Wendkirk, Part IX, pg 20) (FY 2013, Ballinger, Part IX, pg 19)

Table B6. Implementation Schedule

Management Measure	Implementation Schedule
Oil and Gas Operations: Well plugging, Interception and extraction system installation and operation	2004, 2008 2014 - 2016
Continuous water quality monitors	2007 & Ongoing
Salt water diversions	2007, & Ongoing
Salt Cedar Control: Brush control	2004
Water Quality Assessment: Monitoring	Ongoing -Quarterly
Education and Outreach: Stakeholder meetings, Website update	Ongoing -Semi-annual

Element G – Interim Milestones

A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

Milestones are established to reflect the nature of the work being performed. Milestones were established and accomplished in earlier projects. Current milestones are specified for proposed and ongoing work in the watershed. (I-Plan: pg 14, Tbl 1)

Oil and Gas Operations

Runnels County Project - Complete

- 183 abandoned oil wells plugged

Wendkirk and Ballinger Oil Field FY 2004 Projects – Complete

- Mays-01 contaminated water well plugged
- Wolverton oil Well No. 1 plugged

Wendkirk and Ballinger Oil Field FY 2013 Proposed Projects

- BMP Design – 1st quarter FY 20015
- BMP Construction – 3rd quarter FY 2015
- BMP Effectiveness Monitoring – 2nd quarter FY 2016
- Project Final Report – 4th quarter FY 2016

Spence Reservoir Management

Continuous Monitoring and Salt Water Diversions – Ongoing, impacted by drought conditions.

Brush Control

Salt Cedar Brush Removal – Complete, 11,391 acres treated

Water Quality Monitoring

State Water Quality Assessment – Ongoing, Quarterly sampling, Bi-annual assessment

Education and Outreach

Stakeholder Meetings – Ongoing, Semi-annual

Element H – Criteria to Evaluate Water Quality

A set of criteria that will be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

Criteria to evaluate water quality are the water quality assessments performed by the TCEQ. A phased approach was selected to determine the progress of the I-Plan. Implementing TMDLs under the phased approach establishes a timetable for the evaluation of management measures, data collection, the assessment for water quality standards attainment, and if needed, additional predictive modeling. The evaluation of management measures for Segment 1426 was scheduled in three separate phases in the TMDL.

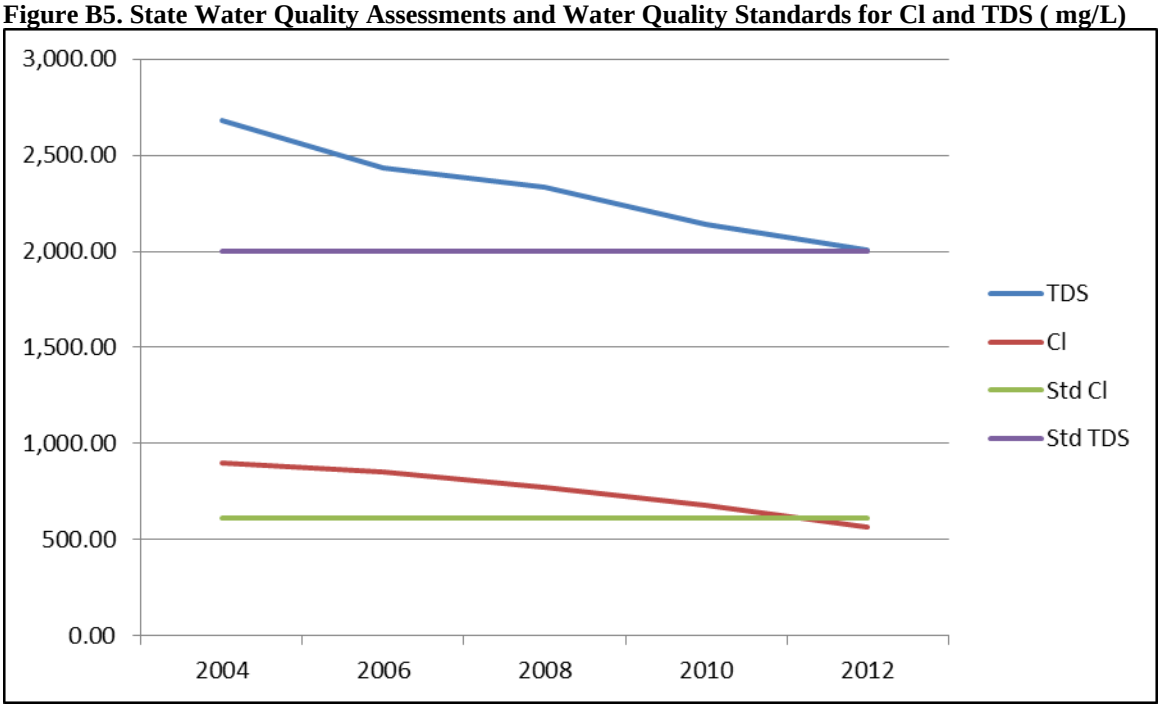
- Phase I of implementation plan progress will begin upon adoption (2007) of the plan by the commission.
- Phase II will commence after three years (2010) upon determination that Phase I BMPs have not improved water quality sufficiently to achieve water quality standards.
- Phase III will begin after eight years (2015) of implementation upon determination that Phase II BMPs have not improved water quality sufficiently to achieve water quality standards.

The results of the TCEQ water quality assessments are given below in Table B7 and Figure B5. As can be observed in the table, concentrations of TDS and chloride in Segment 1426 have consistently declined since the 2004 assessment. Chloride was de-listed in the 2012 assessment and TDS is only 0.2 % above its criteria.

Table B7. State Water Quality Assessments, Segment 1426

State Water Quality Assessment Year	TDS	Chloride
2012	2,004.48	568.68
2010	2,141.87	681.24
2008	2,334.47	775.21
2006	2435.0	852.0
2004	2,680.	898.

Figure B5. State Water Quality Assessments and Water Quality Standards for Cl and TDS (mg/L)



The results of the periodic evaluation of water quality in the Colorado River suggest that the current approach is showing success and should be continued. (I-Plan: pgs 14-15, Tbl 1) (2012 IR, Waterbody Assessments, Segment 1426)

Adaptive Management

The proposed projects are expected to perform and achieve pollutant load reductions as specified in the project proposals. Pollutant load reductions estimated to be needed to achieve WQS are specified in the TMDL documents. Pollutant load reductions from the implementation of management measures in the past are not available. TCEQ cannot fully anticipate water quality conditions in the Colorado River below Spence Reservoir in the future. As described in the TMDL documents and the Bridge document, releases from Spence Reservoir have a significant impact on water quality in the river downstream.

The proposed projects will have significant benefit on water quality and, based on an evaluation of current water quality trends observed in the river, have a high likelihood of attaining water quality standards. The Bridge document provides for a monitoring and evaluation process to determine the actual effectiveness of the management measures. Decisions regarding the need for additional management measures will be made based upon these results.

Element I – Monitoring Component

A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above. The water quality monitoring plan for the Colorado River consists of the RRC performing edge of the implementation activities monitoring and the TCEQ monitoring the in-stream water quality through the quarterly monitoring. The results of this monitoring will be measured against the WQS targets for the management measures and in-stream conditions.

State Water Quality Assessment

The biennial state water quality assessment is based upon water quality monitoring conducted in the Colorado River. The CRP monitoring plan for Segment 1426 in FY 2014 is given below in Table B8. (I-Plan pg 14, Tbl 1) (CRP, 2014, Segment 1426)

Table B8. FY 2014 CRP Water Quality Monitoring Plan for Segment 1426 (# of events per year)

Station Id	Conventional Parameters	Bacteria	Flow	Field Parameters
13651	4	4	4	4
16901	4	4	4	4
17244	4	-	4	4
18338	4	-	4	4
12180	2	2	-	2
15536	4	4	4	4
17474	4	4	4	4
16899	4	4	4	4

Project BMP Effectiveness Monitoring

The RRC is proposing to conduct water quality monitoring as part of the Section 319 FY 2013 BMP implementation projects. This monitoring will be conducted to assess the effectiveness of the BMPs. The effectiveness of the remedial actions (salt load reduction) at the Wendkirk and Ballinger Oil Field sites will be determined by quarterly sampling of the groundwater monitoring wells and surface water in the Colorado River. Samples will be analyzed for salinity parameters including chloride and other anions, total dissolved solids, cations, alkalinity, pH, and specific conductance. The goal is the reduction of salinity levels in Segment 1426 which will be measured by referenced sampling and calculations. The results will be summarized in quarterly reports. The RRC will monitor the amount of water and salinity recovered from the extraction system to determine the salt load. The salt load reduction over time will be graphed and evaluated to determine if salinity levels are decreasing. The sampling results will be compared to the predicted transport modeling results to monitor and augment recovery efforts. (FY 2013,

Wendkirk, Task 4, pg 17) (FY 2013, Ballinger, Task 4, pg 16)