Sampling Summary

Lower Pecos River Watershed

Water Quality Survey

Survey Conducted
March – November 2013

Summary Prepared
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Monitoring, Assessment, and Standards Section
Surface Water Quality Bureau
New Mexico Environment Department
P.O. Box 2610
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Abbreviations

AP	Assessment Protocol
AU	Assessment Unit
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe
CWA	Clean Water Act
FR	Forest Road
FSP	Field Sampling Plan
HP	Hydrology Protocol
IR	State of New Mexico Clean Water Act §303(d)/305(b) Integrated Report
km	kilometer
m	meter
MASS	Monitoring, Assessment, and Standards Section
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
PSRS	Point Source Regulation Section
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SLD	Scientific Laboratory Division
SOP	Standard Operating Procedures
SVOC	Semi-Volatile Organic Compounds
SWQB	Surface Water Quality Bureau
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
THM	Total Heavy Metals
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WQCC	Water Quality Control Commission
WPS	Watershed Protection Section
WQS	Water Quality Standard
WWTP	Wastewater Treatment Plant

Introduction

For purposes of this study, the lower Pecos watershed is defined as the main stem Pecos River from Sumner Dam downstream to the New Mexico-Texas border, and its tributaries (including tributaries of tributaries) entering the river within the above described reach. Tributaries sampled in this study include Rio Hondo, North Spring River, Black River, Delaware River, Sitting Bull Creek, and Rattlesnake Spring.

The elevation below Sumner Dam is 1263 m (4143 ft); the Pecos exits New Mexico at the Texas border at an elevation of 866 m (2840 ft), the lowest point in the state. From Sumner Dam to the Texas border, the main stem of the Pecos River flows through two Omernick Level IV ecoregions, Conchos/Pecos Plains (26n) and Chihuahuan Basins and Playas (24a) (Griffith, et al., 2006).

The area of the surveyed watershed is 46,959.25 km^2, of which 1,3048.80 km^2 (27.8%) is in Chaves County, 1,3048.80 km^2 (0.33%) is in Curry County, 5,874.11 km^2 (12.51%) is in De Baca County, 10,503.21 km^2 (22.37%) is in Eddy County, 1,743.17 km^2 (3.71%) is in Guadalupe County, 5,585.80 km^2 (11.89%) is in Lea County; 6,330.73 km^2 (13.48%) is in Lincoln County; 1,007.87 km^2 (2.14%) is in Otero County; 1,050.95 km^2 (2.24%) is in Quay County; 1,009.99 km^2 (2.15%) is in Roosevelt County; and 647.31 km^2 (1.38%) is in Torrance County. Historic and current land uses in the lower Pecos River watershed include agriculture (range, pasture, and croplands), barren land, commercial, forest, grassland, residential, shrubland, water, and wetlands. Land ownership in the watershed includes the Bureau of Land Management (BLM), U.S. Forest Service (USFS), Bureau of Reclamation (BOR), U. S. Fish and Wildlife Service (USFWS), National Park Service (NPS), New Mexico State Parks (NMSP), New Mexico Department of Game and Fish (NMDGF), Department of Defense (DOD), and state, tribal, and private parcels.

Conchos/Pecos Plains, contained within the Southwestern Tablelands Level III ecoregion, is characterized by broad, rolling plains intersected by mostly ephemeral tributaries to the Pecos. Soils are primarily from Quaternary, Triassic, and Permian sediments. Upland vegetation is dominated by blue grama (*Bouteloua gracilis*), galleta (*Pleuraphis* spp.), sand dropseed (*Sporobolus cryptandrus*), threeawns (*Aristida* spp.), ring muhly (*Muhlenbergia torreyi*), broom snakeweed (*Gutierrezia sarothrae*), prickly pear cacti (*Opuntia* spp.), yucca (*Yucca* spp.), and cholla (*Cylindropuntia* spp.). Riparian vegetation includes cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*), and salt cedar (*Tamarix* spp.). Salt cedar, a non-native originating in Asia, is currently the subject of biocontrol efforts from an introduced predator, Tamarisk leaf beetle (*Diorhabda elongata*). This beetle was observed by SWQB staff from the Roswell area south to the confluence of the Pecos and Black rivers. The beetle is spreading and is expected to appear as far north as Fort Sumner in the near future.

Chihuahuan Basins and Playas, contained within the Chihuahuan Deserts Level III ecoregion, is characterized by saline and alkaline soils. Native vegetation has evolved to withstand high seasonal and diel temperature swings and extreme aridity. Upland vegetation is dominated by creosotebush (*Larrea tridentata*), and also includes fourwing saltbush (*Atriplex canescens*), tarbush (*Flourensia cernua*), various acacias (*Senegalia gregii, Vachellia constricta*, etc.), gypsum grama (*Bouteloua breviseta*), alkali sacaton (*Sporobolus airoides*), and various cacti (several of which are listed under the Endangered Species Act). Salt cedar is common in riparian areas. Pecos sunflower (*Helianthus paradoxus*), a species listed federally as threatened, is found along the lower reaches of Rio Hondo on the Bitter Lake National Wildlife Refuge.

Terrestrial and semi-aquatic fauna and aquatic invertebrates (with an emphasis on listed, rare, or endemic species) that are dependent or closely associated with aquatic and riparian habitats in the lower Pecos watershed include various toads and frogs, including the rare barking frog (*Eleutherodcatylus augusti*), known from Bottomless Lakes State Park near Roswell; northern cricket frog (*Acris crepitans*), known in New Mexico only in the lower Pecos watershed; Rio Grande leopard frog (*Lithobates berlandieri*), known in New Mexico only in Eddy County; turtles, including western river cooter (*Pseudemys gorzugi*), found in New Mexico only along the Pecos, Black, and Delaware rivers; snakes, including plainbelly water snake (*Nerodia erythrogaster*), documented in New Mexico only in Eddy County; western ribbon snake (*Thamnophis proximus*), found in New Mexico primarily along the Pecos and Black rivers; southwestern willow flycatcher (*Empidonax traillii extimus*), piping plover (*Charadrius melodus*), and least tern (*Sterna antillarum*) (these last three bird species are all federally listed); Pecos assiminea (*Assiminea pecos*), a listed snail found at Bitter Lake National Wildlife Refuge; Roswell springsnail (*Pyrgulopsis roswellensis*), listed and endemic to the Roswell area; Koster's springsnail (*Juturnia kosteri*), another listed species found at Bitter Lake National Wildlife Refuge; and Noel's amphipod (*Gammarus desperatus*), a listed freshwater shrimp also found at Bitter Lake National Wildlife Refuge.

Bitter Lake National Wildlife Refuge near Roswell has one of the most diverse Odonata (dragonfly and damselfly) communities in North America.

The lower Pecos contains the most speciose native fish community in New Mexico, with at least 35 native species believed to have existed historically, and 33 documented in museum records. Of these, eight are federally or state-listed as threatened or endangered. These are Pecos bluntnose shiner (*Notropis simus pecosensis*); blue sucker (*Cycleptus elongatus*); gray redhorse (*Moxostoma congestum*); Mexican tetra (*Astyanyax mexicanus*); Pecos gambusia (*Gambusia nobilis*); Pecos pupfish (*Cyprinodon pecosensis*); bigscale logperch (*Percina macrolepida*); and greenthroat darter (*Etheostoma lepidum*) (Sublette et al., 1990).

A notable feature of the geohydrology of the Lower Pecos is the influence of the Karst geology and the resulting Roswell Artesian Basin. This aquifer reveals itself in numerous cenotes (groundwater-fed sinkholes), particularly at Bottomless Lakes State Park, east of Roswell. Water from this aquifer feeds the Pecos River through overland flow from various cenotes and through groundwater.

Personnel Roles and Responsibilities

The Surface Water Quality Bureau (SWQB) Monitoring, Assessment and Standards Section (MASS) staff primarily conducted this survey, but staff from other sections within SWQB were involved with planning, carrying out the work, and using the data. Individual roles and responsibilities are described in Table 1.

Table 1. Personnel roles and responsibilities

Name	Position / Role	Responsibilities
Scott Murray 505-827-2621 Gary Schiffmiller 505-827-2470	Monitoring Staff	• Planned survey • Collected and documented chemical, biological, and habitat samples • Provided chemical, biological, and habitat results for final report • Wrote survey report
Charles Dentino (505) 827-0101	Lakes Coordinator	• Project coordinator duties pertaining to lakes.
Kristine Pintado (505) 827-2822	Standards Liaison	• Provides information and data needs pertaining to water quality standards development and refinement located within the study area.
Chris Canavan 575-647-7926	Watershed Protection Section (WPS) Liaison	• Provided information and data needs pertaining to nonpoint sources of pollution and best management practices (BMPs) located within the study area
Barbara Cooney 505-827-0212 Sandra Gabaldon 505-827-1041	Point Source Regulation Section (PSRS) Liaison	• Provided information and data needs pertaining to point source discharges located within the study area • Assisted with development of final survey report
Heidi Henderson 505-827-2901	Total Maximum Daily Load (TMDL) Liaison	• Provided information and data needs pertaining to TMDL development to be conducted in the study area • Assisted with development of final survey report; will develop TMDLs as needed

Objectives

This survey had several objectives because the data generated must serve the needs of all sections within the SWQB. These objectives are outlined in Table 2.

Table 2. Survey Objectives

	Intended use of data	Question to be answered	Products/ Outcomes	Decision Criteria
Primary Objectives	Assess designated use attainment for the New Mexico Clean Water Act (CWA) §303(d)/305(b) *Integrated Report (IR)* and provide information to the public on the condition of surface water	Are sampled waterbodies meeting water quality standards (WQS) criteria?	Survey Report, IR	WQS as interpreted by the Assessment Protocols (APs)
	Develop or refine surface WQS	Are the existing uses and/or criteria appropriate for the waterbody?	Use Attainability Analyses (UAA), Amendments to WQS	Are data sufficient to support a petition to the Water Quality Control Commission (WQCC) to revise WQS?
Secondary Objectives	Develop load and waste load allocations for TMDLs	What is the maximum pollutant load a waterbody can receive and meet the requirements of the WQS?	TMDL loading calculations and National Pollutant Discharge Elimination System (NPDES) permit limits	WQS as interpreted by the APs
	Evaluate restoration and mitigation measures implemented to control NPS pollution	Have watershed restoration activities and mitigation measures improved water quality?	Project Summary Reports, Nonpoint Source (NPS) Annual Report, *IR (De-Listing)*	WQS as interpreted by the APs

Schedule

This survey was made up of many components beginning with planning and ending with the generation of the State of New Mexico Clean Water Act (CWA) Section 303(d)/305(b) Integrated Report (IR). Total Maximum Daily Loads (TMDLs), if necessary, will be written in the winter of 2014-2015. A tentative schedule (Table 3) shows that completion of the entire project will take four years. As part of the survey planning process a public meeting was held to answer questions and solicit input for the survey. This meeting took place January 24, 2013 at the Eastern New Mexico State University campus in Roswell, NM.

Table 3. Project Schedule

Activity	Win '12-13	Spr '13	Sum '13	Fall '13	Win '13-'14	Spr '14	Sum '14	Fall '14	Win '14-15	Spr '15	Sum '15	Fall '15	Win '15-16
Survey planning, site reconnaissance, public input period	========►												
Data collection, sample submittal to SLD		==========►											
Data verification & validation, data assessment				==========►									
Preparation of survey report, TMDL development								==========►					

Sampling Plan

The survey included chemical samples, which were collected monthly between January and December 2013; biological sampling, scheduled to be conducted within the index period (August 15 - November 15, 2013) to standardize life stages at the time of sampling; and habitat measurements that were taken during periods of base flow. Data were collected according to SWQB standard operating procedures (SOPs; NMED/SWQB 2007-2011) and the field sampling plan (FSP). Because of extreme weather events and subsequent flooding and scouring flows during the 2013 and 2014 field seasons, biological and habitat sampling was postponed until the 2015 field season.

Chemical Sampling

Chemical sampling sites generally were allocated one per assessment unit (AU) and were usually located near the lower end of the AU, access permitting. Additional stations were located to document conditions above and below potential pollution sources (e.g., point sources). Stations from previous surveys were used whenever practicable to evaluate trends. Water samples for chemical analyses were submitted to the New Mexico Scientific Laboratory Division (SLD). *E.coli* samples were processed in the SWQB laboratory or with mobile equipment. Water quality analytes and their sampling frequencies are outlined in Table 4 and the location of sampling stations is shown in Figure 1. In addition to the analytes listed, field measurements (temperature, specific conductance, dissolved oxygen concentration and percent saturation, pH, and turbidity) were taken during each sampling

visit or during deployments of 3-21 days with a multi-parameter sonde. Secchi depth readings, as well as depth profiles, also obtained with a multi-parameter sonde, were recorded as part of lake/reservoir sampling visits.

Table 4. Water Chemistry Sampling Summary. The first number in each cell represents the number of samples scheduled; the second number represents the number of samples taken.

Map ID	Station Name	Assessment Unit (AU)	TSS only	TDS/TSS	Chloride and Sulfate	Nutrients [1]	Total Metals (Hg, Se, Al)	Dissolved Metals [2]	E. coli	VOC [3]	SVOC [3]	Radionuclides [4]	Cyanide	Station Rationale
1	Pecos River at Sumner Dam	Pecos River (Salt Creek to Sumner Dam)		8/8	8/8	8/8	4/5	4/5	8/8					Most upstream point in survey
2	Pecos River above Fort Sumner WWTP	Pecos River (Salt Creek to Sumner Dam)	8/6			8/6			8/6					Bracket point source
3	Fort Sumner WWTP effluent	Pecos River (Salt Creek to Sumner Dam)	8/8			8/8			8/8					Point source monitoring
4	Pecos River blw Fort Sumner WWTP	Pecos River (Salt Creek to Sumner Dam)	8/8			8/8			8/8					Bracket point source
5	Pecos River below 6 Mile Draw	Pecos River (Salt Creek to Sumner Dam)		8/8	8/8	8/8	4/5	4/5	8/8					Bottom of proposed AU
6	Pecos River at Bitter Lake NWR, North Unit	Pecos River (Salt Creek to Sumner Dam)		8/7	8/7	8/7	4/3	4/3	8/7					Bottom of AU; minimally impacted
7	Pecos River at US 380, Tatum Bridge	Pecos River (Rio Felix to Salt Creek)		8/8	8/8	8/7			8/8					Bracket major tributary (Rio Hondo)
8	North Spring River @ RR trestle	North Spring River (Rio Hondo to headwaters)	8/6			8/6			8/5					Bracket potential point source
9	North Spring River at Loveless Park	North Spring River (Rio Hondo to headwaters)	8/7			8/7			8/6					Bracket potential point source

Map ID	Station Name	Assessment Unit (AU)	TSS only	TDS/TSS	Chloride and Sulfate	Nutrients [1]	Total Metals (Hg, Se, Al)	Dissolved Metals [2]	E. coli	VOC [3]	SVOC [3]	Radionuclides [4]	Cyanide	Station Rationale
10	Rio Hondo above Roswell WWTP effluent	Rio Hondo (Pecos River to North Spring River)		2/2		2/2	2/2	2/2	2/2					Bracket point source (when discharging)
11	Roswell WWTP effluent	Rio Hondo (Pecos River to North Spring River)		2/2		2/2	2/2	2/2	2/2					Point source monitoring
12	Rio Hondo blw Roswell WWTP	Rio Hondo (Pecos River to North Spring River)		2/2		2/2	2/2	2/2	2/2					Bracket point source (when discharging to river)
13	Rio Hondo at 380 Bridge	Rio Hondo (Pecos River to North Spring River)		4/4		4/4	4/4	4/4	4/3					Bracket USFWS restoration project
14	Rio Hondo abv Pecos River	Rio Hondo (Pecos River to North Spring River)		8/8	8/8	8/7	4/4	4/4	8/7	2/1	2/1	2/2		Bracket USFWS restoration project; Bottom of AU
15	Pecos River blw Rio Hondo	Pecos River (Rio Felix to Salt Creek)		8/8	8/8	8/7			8/8					Bracket major tributary (Rio Hondo)
16	Pecos River @ Wichita Rd. near Dexter	Pecos River (Rio Felix to Salt Creek)		8/8	8/8	8/8	4/4	4/4	8/8					Bottom of AU
17	Pecos River near Lake Arthur	Pecos River (Brantley headwaters to Rio Felix)	Temperature data logger											
18	Pecos River above Artesia WWTP effluent	Pecos River (Brantley headwaters to Rio Felix)		2/2		2/2	2/2	2/2	2/2	0/1	0/1			Bracket point source (when discharging to river)
19	Artesia WWTP effluent at Pecos River	Pecos River (Brantley headwaters to Rio Felix)		2/2		2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	Point source monitoring

Map ID	Station Name	Assessment Unit (AU)	TSS only	TDS/TSS	Chloride and Sulfate	Nutrients [1]	Total Metals (Hg, Se, Al)	Dissolved Metals [2]	E. coli	VOC [3]	SVOC [3]	Radionuclides [4]	Cyanide	Station Rationale
20	Pecos River at US 82 bridge near Artesia	Pecos River (Brantley headwaters to Rio Felix)		2/2		2/2	2/2	2/2	2/2					Bracket point source (when discharging)
21	Pecos River above Rio Penasco	Pecos River (Brantley headwaters to Rio Felix)	Habitat data collection (representative of typical habitat)											
22	Pecos River above Brantley Reservoir near Lakewood	Pecos River (Brantley headwaters to Rio Felix)		8/8	8/8	8/8	4/3	4/3	8/8					Bottom of AU; Brantley inflow
23	Pecos River below Brantley Dam	Pecos River (Avalon Reservoir to Brantley Reservoir)	8/8			8/8	4/3	4/3	8/8					Only station in AU; lake outflow
24	Pecos River below Lower Tansil Dam	Pecos River (Black River to Lower Tansil Dam)		8/8	8/8	8/7	4/4	4/4	8/8					Bracket point source; lake outflow
25	Carlsbad WWTP	Pecos River (Black River to Lower Tansil Dam)		8/8		8/8	4/4	4/4	8/8					Point source monitoring
26	Pecos River below Carlsbad WWTP near Otis	Pecos River (Black River to Lower Tansil Dam)		8/8	8/8	8/8	4/4	4/4	8/8					Bracket point source
27	Pecos River below Ten Mile Dam	Pecos River (Black River to Lower Tansil Dam)		4/4	4/4	4/4		4/4	4/4					Bracket potential influence of potash mining
28	Pecos River above Black River	Pecos River (Black River to Lower Tansil Dam)		8/8	8/8	8/8	4/4	4/4	8/8					Bottom of AU; bracket major tributary
29	Rattlesnake Spring	Rattlesnake Spring (Black River to headwaters)	4/4			4/3			4/4	2/1	2/1			Drinking water source for Carlsbad Caverns National Park

Map ID	Station Name	Assessment Unit (AU)	TSS only	TDS/TSS	Chloride and Sulfate	Nutrients [1]	Total Metals (Hg, Se, Al)	Dissolved Metals [2]	E. coli	VOC [3]	SVOC [3]	Radionuclides [4]	Cyanide	Station Rationale
30	Black River at headwater spring	Black River (Blue Spring to headwaters)		8/8	8/8	8/8	4/4	4/4	8/8	4/4	4/4			Most upstream station on major tributary
31	Black River abv Blue River	Black River (Blue Spring to headwaters)		8/8	8/8	8/7	4/4	4/4	8/8	4/4	4/4			Bottom of AU
32	Blue Spring	Blue Spring (Black River to headwaters)	4/4			4/3			4/4	2/2	2/2			Only station in AU; occupied habitat of several listed species
33	Black River blw RR Xing	Black River (Pecos River to Blue Spring)		8/8	8/8	8/8	4/4	4/4	8/8	4/4	4/4	2/2		Bottom of AU
34	Pecos River below Black River (Harroun Crossing)	Pecos River (TX border to Black River)		8/7	8/7	8/7		4/4	8/8					Bracket major tributary; bracket Malaga Bend salt springs
35	Pecos River at Pierce Canyon Crossing	Pecos River (TX border to Black River)		8/8	8/8	8/8		4/4	8/8			2/2		Bracket Malaga Bend salt springs
36	Pecos River near Red Bluff	Pecos River (TX border to Black River)		0/5	0/5	8/7	0/4	4/4	8/8	4/3	4/3			Bottom of AU
37	Delaware River at US 285	Delaware River (Pecos River to TX border)		8/6	8/6	8/6	4/4	4/4	8/6	4/2	4/2	2/2		Bottom of AU
38	Sitting Bull Creek below recreation area	Sitting Bull Creek (Last Chance Canyon to Sitting Bull Spring)	4/4			4/3			4/4					Bottom of AU
QC	*Number of field, equipment, reagent and bacterial blanks collected per QAPP.*		*-*	*-*	*-*	*12/8*	*-*	*8/8*	*8/8*	*8/8*	*-*	*-*		

Map ID	Station Name	Assessment Unit (AU)	TSS only	TDS/TSS	Chloride and Sulfate	Nutrients [1]	Total Metals (Hg, Se, Al)	Dissolved Metals [2]	E. coli	VOC [3]	SVOC [3]	Radionuclides [4]	Cyanide	Station Rationale
		TOTALS	**60/ 55**	**164/ 165**	**140/ 141**	**240/ 224**	**76/ 79**	**100/ 99**	**240/ 228**	**36/ 32**	**28/ 24**	**10/ 10**	**2/2**	

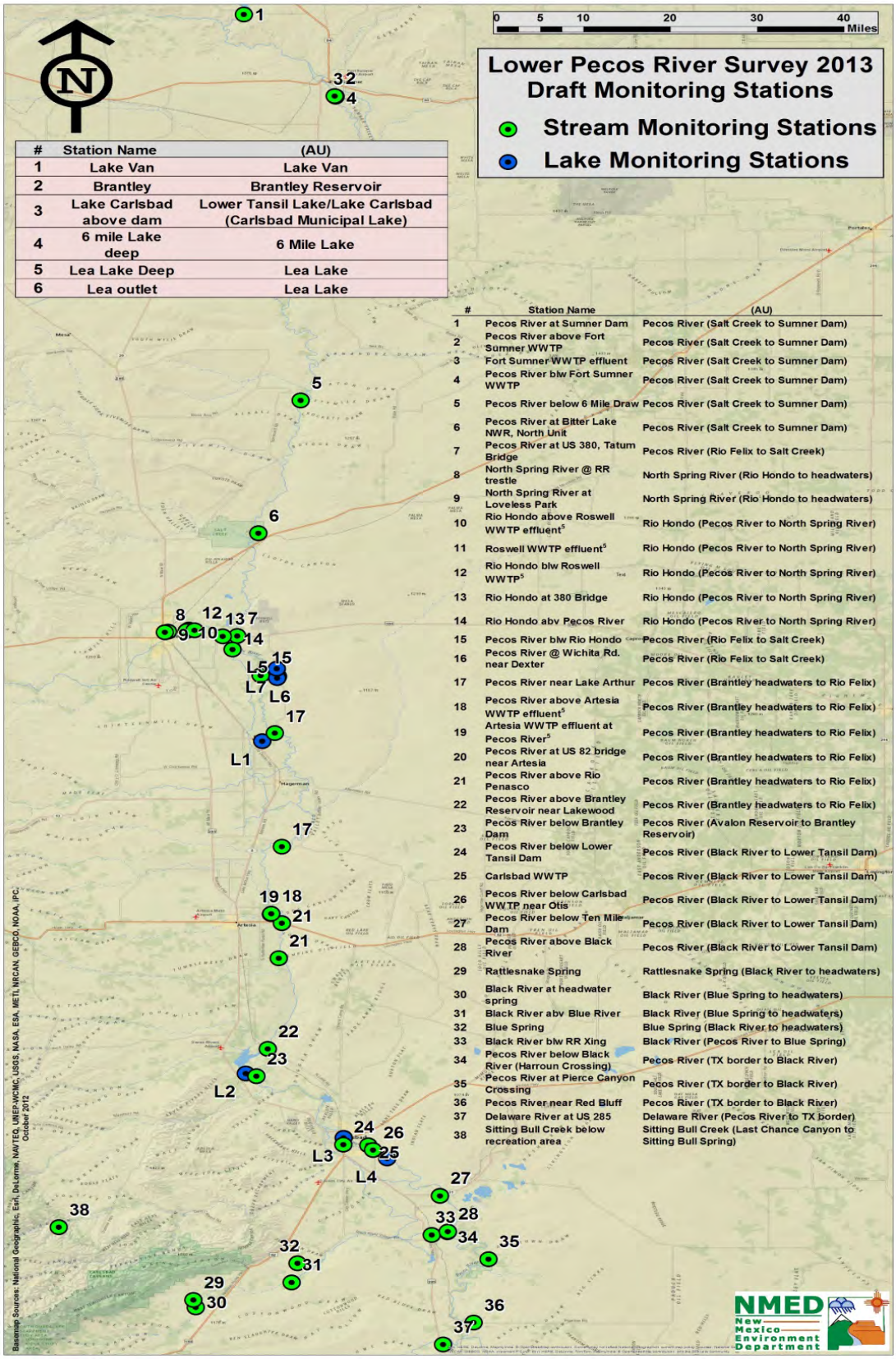
[1]Total Suspended Solids / Total Dissolve Solids.
[2]Suite includes total Kjeldahl nitrogen (TKN), nitrate+nitrite, ammonia and total phosphorus.
[3]Suite includes aluminum, antimony, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, silicon, silver, tin, vanadium, zinc and hardness.
[4]Aluminum, selenium and mercury only.
[5]A radionuclide sample is initially analyzed for gross alpha and gross beta radiation and,depending on results of the gross alpha and gross beta screen, might also include uranium mass and radium 226 + 228.
[6]Volatile Organic Compounds; see Appendix A for a list of analytes included in the suite.
[7]Semi-Volatile Organic Compounds; see Appendix A for a list of analytes included in the suite.

Table 5. Water chemistry sampling summary. (Lakes) The first number in each cell represents the number of samples scheduled; the second number represents the number of samples taken.

Map ID	Station Name	Assessment Unit (AU)	TSS only	Nutrients [1]	Total Metals (Hg, Se, Al)	Dissolved Metals [2]	E. coli	VOC [3]	SVOC [3]	Radionuclides [4]
1	Lake Van – deep	Lake Van	4/4	4/4	4/4	4/4	4/4	2/2	2	2
2	Brantley Reservoir – deep	Brantley Reservoir	4/4	4/4	4/4	4/4	4/4	2/2	2	2
3	Lake Carlsbad above dam	Lower Tansil Lake/ Lake Carlsbad	4/4	4/4	4/4	4/4	4/4	2/2	2	2
4	6 Mile Lake – deep	6 Mile Lake	4/4	4/4	4/4	4/4	4/4	2/2	2	2
5	Lea Lake – deep	Lea Lake	4/4	4/4	4/4	4/4	4/4	2/2	2	2
6	Lea Lake – outlet	Lea Lake	4/4	4/4			4/4	2/2	2	2
7	Figure 8 Lake – deep	Figure 8 Lake	4/4	4/4	4/4	4/4	4/4	2/2	2	2
QC	*Number of field, equipment, reagent and bacterial blanks collected per QAPP.*		*-*	*4/8*	*-*	*4/8*	*4/8*	*2/4*	*-*	*-*
		TOTALS	**28/28**	**32/36[5]**	**24/24**	**28/32[5]**	**32/36[5]**	**16/18[5]**	**14**	**14**

[1] Suite includes total Kjeldahl nitrogen, nitrate+nitrite, ammonia and total phosphorus.
[2] Suite includes aluminum, antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, silicon, silver, tin, vanadium and zinc PLUS calcium and magnesium
[3] See Appendix B for a complete list of analytes.
[4] A radionuclide sample will include gross alpha and gross beta and depending on detections may include Uranium mass and Radium 226 + 228.
[5] Blanks were increased based on the number of sampling runs.

Figure 1. Location of sampling stations in Lower Pecos Watershed.



#	Station Name	(AU)
1	Lake Van	Lake Van
2	Brantley	Brantley Reservoir
3	Lake Carlsbad above dam	Lower Tansil Lake/Lake Carlsbad (Carlsbad Municipal Lake)
4	6 mile Lake deep	6 Mile Lake
5	Lea Lake Deep	Lea Lake
6	Lea outlet	Lea Lake

#	Station Name	(AU)
1	Pecos River at Sumner Dam	Pecos River (Salt Creek to Sumner Dam)
2	Pecos River above Fort Sumner WWTP	Pecos River (Salt Creek to Sumner Dam)
3	Fort Sumner WWTP effluent	Pecos River (Salt Creek to Sumner Dam)
4	Pecos River blw Fort Sumner WWTP	Pecos River (Salt Creek to Sumner Dam)
5	Pecos River below 6 Mile Draw	Pecos River (Salt Creek to Sumner Dam)
6	Pecos River at Bitter Lake NWR, North Unit	Pecos River (Salt Creek to Sumner Dam)
7	Pecos River at US 380, Tatum Bridge	Pecos River (Rio Felix to Salt Creek)
8	North Spring River @ RR trestle	North Spring River (Rio Hondo to headwaters)
9	North Spring River at Loveless Park	North Spring River (Rio Hondo to headwaters)
10	Rio Hondo above Roswell WWTP effluent[5]	Rio Hondo (Pecos River to North Spring River)
11	Roswell WWTP effluent[5]	Rio Hondo (Pecos River to North Spring River)
12	Rio Hondo blw Roswell WWTP[5]	Rio Hondo (Pecos River to North Spring River)
13	Rio Hondo at 380 Bridge	Rio Hondo (Pecos River to North Spring River)
14	Rio Hondo abv Pecos River	Rio Hondo (Pecos River to North Spring River)
15	Pecos River blw Rio Hondo	Pecos River (Rio Felix to Salt Creek)
16	Pecos River @ Wichita Rd. near Dexter	Pecos River (Rio Felix to Salt Creek)
17	Pecos River near Lake Arthur	Pecos River (Brantley headwaters to Rio Felix)
18	Pecos River above Artesia WWTP effluent[5]	Pecos River (Brantley headwaters to Rio Felix)
19	Artesia WWTP effluent at Pecos River[5]	Pecos River (Brantley headwaters to Rio Felix)
20	Pecos River at US 82 bridge near Artesia	Pecos River (Brantley headwaters to Rio Felix)
21	Pecos River above Rio Penasco	Pecos River (Brantley headwaters to Rio Felix)
22	Pecos River above Brantley Reservoir near Lakewood	Pecos River (Brantley headwaters to Rio Felix)
23	Pecos River below Brantley Dam	Pecos River (Avalon Reservoir to Brantley Reservoir)
24	Pecos River below Lower Tansil Dam	Pecos River (Black River to Lower Tansil Dam)
25	Carlsbad WWTP	Pecos River (Black River to Lower Tansil Dam)
26	Pecos River below Carlsbad WWTP near Otis	Pecos River (Black River to Lower Tansil Dam)
27	Pecos River below Ten Mile Dam	Pecos River (Black River to Lower Tansil Dam)
28	Pecos River above Black River	Pecos River (Black River to Lower Tansil Dam)
29	Rattlesnake Spring	Rattlesnake Spring (Black River to headwaters)
30	Black River at headwater spring	Black River (Blue Spring to headwaters)
31	Black River abv Blue River	Black River (Blue Spring to headwaters)
32	Blue Spring	Blue Spring (Black River to headwaters)
33	Black River blw RR Xing	Black River (Pecos River to Blue Spring)
34	Pecos River below Black River (Harroun Crossing)	Pecos River (TX border to Black River)
35	Pecos River at Pierce Canyon Crossing	Pecos River (TX border to Black River)
36	Pecos River near Red Bluff	Pecos River (TX border to Black River)
37	Delaware River at US 285	Delaware River (Pecos River to TX border)
38	Sitting Bull Creek below recreation area	Sitting Bull Creek (Last Chance Canyon to Sitting Bull Spring)

Nutrient / Habitat Sampling

Biological indicators and habitat measurements give an overall indication of the integrity of the AU. Stations were selected for biological and habitat monitoring based on their current IR status and results of level 1 nutrient assessments. Resources and access issues did not allow for the collection of biological and habitat data in all AUs.

The SWQB collected periphyton and physical habitat data at select sites to assess waterbodies for potential impairment from sediment deposition and nutrient enrichment, and to obtain data to support water quality standards development. Fish data were obtained from collections and from other agencies.

The collection of nutrient response variables, i.e. long term dissolved oxygen and chlorophyll *a*, and physical habitat monitoring require stable conditions in order to collect representative data. Intense flooding in September 2013, and June and October 2014 caused significant scour and disturbances that precluded nutrient and physical habitat sampling. High priority segments are planned for sampling in June 2015. A summary of planned and prioritized biological and habitat monitoring is described in Table 6.

Table 6. Summary of planned data gap monitoring for stream biological and physical parameters. Station numbers refer to locations in Figure 1.

#	Station Name	Assessment Unit	Sonde Deployment	Thermograph	Chlorophyll a	Periphyton – diatoms	Physical Habitat[5]	Nutrient Priority[1]
5	Pecos River at USGS gauge below 6 Mile Draw	Pecos River (Salt Creek to Sumner Dam)	1		1	1	1	L
6	Pecos River at Bitter Lake NWR, North Unit	Pecos River (Salt Creek to Sumner Dam)	1	1	1	1	1	M
13	Rio Hondo abv Pecos River	Rio Hondo (Pecos River to North Spring River)	1	1	1		1	H
15	Pecos River @ Wichita Rd. near Dexter	Pecos River (Rio Felix to Salt Creek)	1	1	1	1	1	M
17	Pecos River near Lake Arthur	Pecos River (Brantley headwaters to Rio Felix)		1				
19	Pecos River above Rio Penasco	Pecos River (Brantley headwaters to Rio Felix)	1		1	1	1	M
20	Pecos River below Brantley Dam	Pecos River (Avalon Reservoir to Brantley Reservoir)					1	L
25	Pecos River above Black River	Pecos River (Black River to Lower Tansil Dam)	1		1	1	1	M

#	Station Name	Assessment Unit	Sonde Deployment	Thermograph	Chlorophyll a	Periphyton – diatoms	Physical Habitat[5]	Nutrient Priority[1]
30	Black River at headwater spring	Black River (Blue Spring to headwaters)	1	1	1		1	M
33	Black River blw RR Xing	Black River (Pecos River to Blue Spring)	1	1	1		1	H
36	Pecos River near Red Bluff	Pecos River (TX border to Black River)	1		1	1	1	M
37	Delaware River at US 285	Delaware River (Pecos River to TX border)	1	1	1		1	H
38	Sitting Bull Creek below recreation area	Sitting Bull Creek (Last Chance Canyon to Sitting Bull Spring)		1			1	L
	QC	Quality Control samples collected per QAPP	-		-	-	1	
	Totals		**10**	**8**	**10**	**6**	**13**	

[1] Nutrient data gap data collection will occur as staff time and resources allow and are prioritized as follows; H-high, M-medium, L-low.

Table 7. Completed biological and habitat sampling summary (Lakes). Station numbers refer to locations in Figure 1.

#	Station Name	Assessment Unit (AU)	Chlorophyll a	Phytoplankton
1	Lake Van	Lake Van	4	4
2	Brantley	Brantley Reservoir	4	4
3	Lake Carlsbad abv Dam	Lower Tansil Lake/Lake Carlsbad (Carlsbad Municipal Lake	4	4
4	6 Mile Lake deep	6 Mile Lake	4	4
5	Lea Lake Deep	Lea Lake	4	4
7	Figure 8 Lake	Figure 8 Lake	4	4
---	*QC*	*Replicate collected per QAPP.*	-	*1*
	Totals		**24/24**	**25/24**

Deviations from the FSP at lake stations were caused by:

1. Lack of water during one visit to Station 6 (Pecos River at Bitter Lake NWR) and two visits to Station 37 (Delaware River at US 285) resulted in collection of fewer samples than planned.
2. High flows impeded access to Station 2 (Pecos River above Fort Sumner WWTP) on two occasions.
3. Laboratory capacity limitations resulted in fewer nutrient samples at several stations.
4. Incubator malfunctions resulted in fewer *E. coli* samples than planned on several occasions.
5. Improper preservation resulted in voiding of one ion sample at Pecos River below Black River.
6. Intense flood events in September 2013 resulted in rescheduling of biological/habitat sampling. Additional flooding in June and October 2014 postponed sampling to June 2015.

Summary

Deviations from the FSP were few and are detailed above. Biological and habitat monitoring were largely the result of intense monsoon rains and subsequent flooding in September 2013, and June and October 2014. In the case of the Pecos River at Bitter Lake NWR, North Unit, the river avulsed after a flood event and the channel moved more than 1 km from its original location. Drying of the channel also prohibited some chemical and biological monitoring. In June and July 2015, biological and physical habitat data gaps sampling will occur at sites previously impacted by intense flooding.

The data from this survey have been validated and verified according to SWQB standard operating procedures (SOPs; NMED/SWQB 2011) and are currently undergoing assessment to determine the impairment status of the sampled waters. The assessment conclusions will be incorporated into the 2014-2016 IR, which was completed early in 2014. These conclusions will be used to generate an amendment to this report, detailing the results. In cases where impairments to water and habitat quality are found, data from this survey will also be used to calculate TMDLs, depending on the outcome of assessments and listing.

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Appendix A. Analytes included in Volatile (VOC) and Semi-volatile (SVOC) organic compound suites.

Semi-Volatile Organic Compounds	Volatile Organic Compounds
1,2,4-Trichlorobenzene	1,1,1,2-Tetrachloroethane
1,2-Dichlorobenzene	1,1,1-Trichloroethane
1,2-Dinitrobenzene	1,1,2,2-Tetrachloroethane
1,3-Dichlorobenzene	1,1,2-Trichloroethane
1,3-Dinitrobenzene	1,1-Dichloroethane
1,4-Dichlorobenzene	1,1-Dichloroethene
1,4-Dinitrobenzene	1,1-Dichloropropene
1-Methylnaphthalene	1,2,3-Trichlorobenzene
2,3,4,6-Tetrachlorophenol	1,2,3-Trichloropropane
2,3,5,6-Tetrachlorophenol	1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol	1,2,4-Trimethylbenzene
2,4,6-Trichlorophenol	1,2-Dibromo-3-chloropropane (DBCP)
2,4-Dichlorophenol	1,2-Dibromoethane (EDB)
2,4-Dimethylphenol	1,2-Dichlorobenzene
2,4-Dinitrophenol	1,2-Dichloroethane
2,4-Dinitrotoluene	1,2-Dichloropropane
2,6-Dinitrotoluene	1,3,5-Trimethylbenzene
2-Chloronaphthalene	1,3-Dichlorobenzene
2-Chlorophenol	1,3-Dichloropropane
2-Methylnaphthalene	1,4-Dichlorobenzene
2-Methylphenol	1,4-Dioxane
2-Nitroaniline	2,2-Dichloropropane
2-Nitrophenol	2-Butanone (MEK)
3,3'-Dichlorobenzidine	2-Chloroethyl vinyl ether
3-Methylphenol & 4-Methylphenol	2-Chlorotoluene
3-Nitroaniline	2-Hexanone
4,4'-DDD	4-Chlorotoluene
4,4'-DDE	4-Isopropyltoluene
4,4'-DDT	4-Methyl-2-pentanone
4,6-Dinitro-2-methylphenol	Acetone
4-Bromophenyl Phenyl Ether	Acetonitrile
4-Chloro-3-methylphenol	Acrolein
4-Chloroaniline	Acrylonitrile
4-Chlorophenyl Phenyl Ether	Allyl chloride
4-Nitroaniline	Benzene
4-Nitrophenol	Bromobenzene
Acenaphthene	Bromochloromethane
Acenaphthylene	Bromodichloromethane
Alachlor	Bromoform
Aldrin	Bromomethane
alpha-BHC	Carbon disulfide
Aniline	Carbon tetrachloride
Anthracene	Chlorobenzene
Atrazine	Chloroethane
Azobenzene	Chloroform

Semi-Volatile Organic Compounds	Volatile Organic Compounds
Benzidine	Chloromethane
Benzo(a)anthracene	Chloroprene
Benzo(a)pyrene	cis-1,2-Dichloroethene
Benzo(b)fluoranthene	cis-1,3-Dichloropropene
Benzo(g,h,i)perylene	cis-1,4-Dichloro-2-butene
Benzo(k)fluoranthene	Dibromochloromethane
Benzyl alcohol	Dibromomethane
beta-BHC	Dichlorodifluoromethane
bis(2-Chloroethoxy)methane	Ethyl methacrylate
bis(2-Chloroethyl)ether	Ethylbenzene
bis(2-Chloroisopropyl)ether	Hexachlorobutadiene
bis(2-Ethylhexyl)adipate	Iodomethane
bis(2-Ethylhexyl)phthalate	Isobutyl alcohol
Butyl Benzyl Phthalate	Isopropylbenzene
Carbazole	m- & p-Xylenes
Chrysene	Methyl methacrylate
cis-Chlordane	Methylacrylonitrile
Cyanazine	Methylene chloride (Dichloromethane)
delta-BHC	Naphthalene
Dibenz(a,h)anthracene	n-Butylbenzene
Dibenzofuran	Nitrobenzene
Dieldrin	o-Xylene
Diethylphthalate	Pentachloroethane
Dimethylphthalate	Propionitrile
Di-n-butyl Phthalate	Propylbenzene
Di-n-octyl phthalate	sec-Butylbenzene
Endosulfan I	Styrene
Endosulfan II	tert-Butyl methyl ether (MTBE)
Endosulfan sulfate	tert-Butylbenzene
Endrin	Tetrachloroethene
Endrin aldehyde	Tetrahydrofuran (THF)
Endrin ketone	Toluene
Fluoranthene	Total trihalomethanes
Fluorene	Total xylenes
gamma-BHC (lindane)	trans-1,2-Dichloroethene
Heptachlor	trans-1,3-Dichloropropene
Heptachlor epoxide	trans-1,4-Dichloro-2-butene
Hexachlorobenzene	Trichloroethene
Hexachlorobutadiene	Trichlorofluoromethane
Hexachlorocyclopentadiene	Vinyl acetate
Hexachloroethane	Vinyl chloride
Indeno(1,2,3-cd)pyrene	
Isophorone	
Methoxychlor	
Metolachlor	
Metribuzin	
Naphthalene	

Semi-Volatile Organic Compounds	Volatile Organic Compounds
Nitrobenzene	
N-nitrosodimethylamine	
N-nitroso-di-n-propylamine	
N-nitrosodiphenylamine	
Pentachlorophenol	
Phenanthrene	
Phenol	
Prometryne	
Pyrene	
Pyridine	
Simazine	
trans-Chlordane	