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Identifying and Characterizing the Volume and Quality of Tributaries and Springs

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Introduction

In order to identify potential salinity sources, it was necessary to locate and characterize the potential impact of perennial and intermittent tributaries into the Pecos River. A study to determine water quantity, quality, and point of impacts from sources outside of the main stem was conducted in 2005. The first phase involved analyzing maps to determine potential tributary locations and to locate sampling points based on accessibility. The second phase was to acquire water and sediment samples, determine flow volume, and submit samples for laboratory analysis. In the case of dry streambeds that could potentially carry water during storm events, sediment samples were collected for laboratory analysis. This report summarizes the sample collection efforts and analysis of data collected from tributaries.

Background

The Pecos River travels southward for over 900 miles from its headwaters in the Sangre de Cristo Mountains just east of Santa Fe, New Mexico to its confluence with the Rio Grande upstream of Amistad Lake. Major tributaries feeding into the Pecos River are the Gallinas River near Las Vegas, New Mexico; Alamogordo Creek and Taiban Creek near Fort Sumner, NM; the Rio Hondo near Roswell, NM; Rio Felix south of Roswell, NM; Rio Penasco near Artesia, NM; the intermittent Delaware River just west of Red Bluff Reservoir; Salt Creek in Reeves County, TX; Toyah Creek in Reeves County, Texas; and Independence Creek in Terrell County, TX.

Most of the above named tributaries lie in New Mexico and enter the Pecos above Red Bluff Reservoir, generally contributing fresher water than the Pecos River and the underlying aquifers. In Texas, Salt Creek provides readily observable surface flow and high salt loading in the Upper Pecos and Independence Creek provides high quality water to the river in the Lower Pecos. The remaining tributaries in Texas are intermittent and typically only carry flow during high volume rain events.

The Pecos River runs through the Trans-Pecos Region of Texas. This region is characterized by semi-arid environment on the eastern edge of the Basin and Range province. Annual average rainfall in the basin is typically around 12 inches with about three-fourths of the annual precipitation falling during July, August, and September. The terrain for most of the Upper Pecos River is generally flat. The geology is predominantly calcareous limestone with sandy loam soils. Rainfall is absorbed into the ground through most of the region and never enters the mainstem of the river except during high rainfall events. During these events, water flash floods through the creek beds and transfers high amounts of surface sediment to the river. After the rain

event is complete, creeks rapidly dry up and water is evaporated due to high temperatures and low relative humidity.

Figure 1. Pecos River

Sampling

The only tributary of the Pecos that contains a routine monitoring site is Independence Creek, therefore, samples were collected on Salt Creek for water quality analysis and sediment samples were collected in the bed of several intermittent streams in Texas. Figure 2 shows a map of the sample site locations where water quality samples in the mainstem and Salt Creek were collected and where sediment samples were taken from intermittent tributaries. Water samples were collected on two events in Salt Creek on March 8, 2005 and July 12, 2005. Sediment samples in intermittent streams were collected at the sites on August 26, 2005

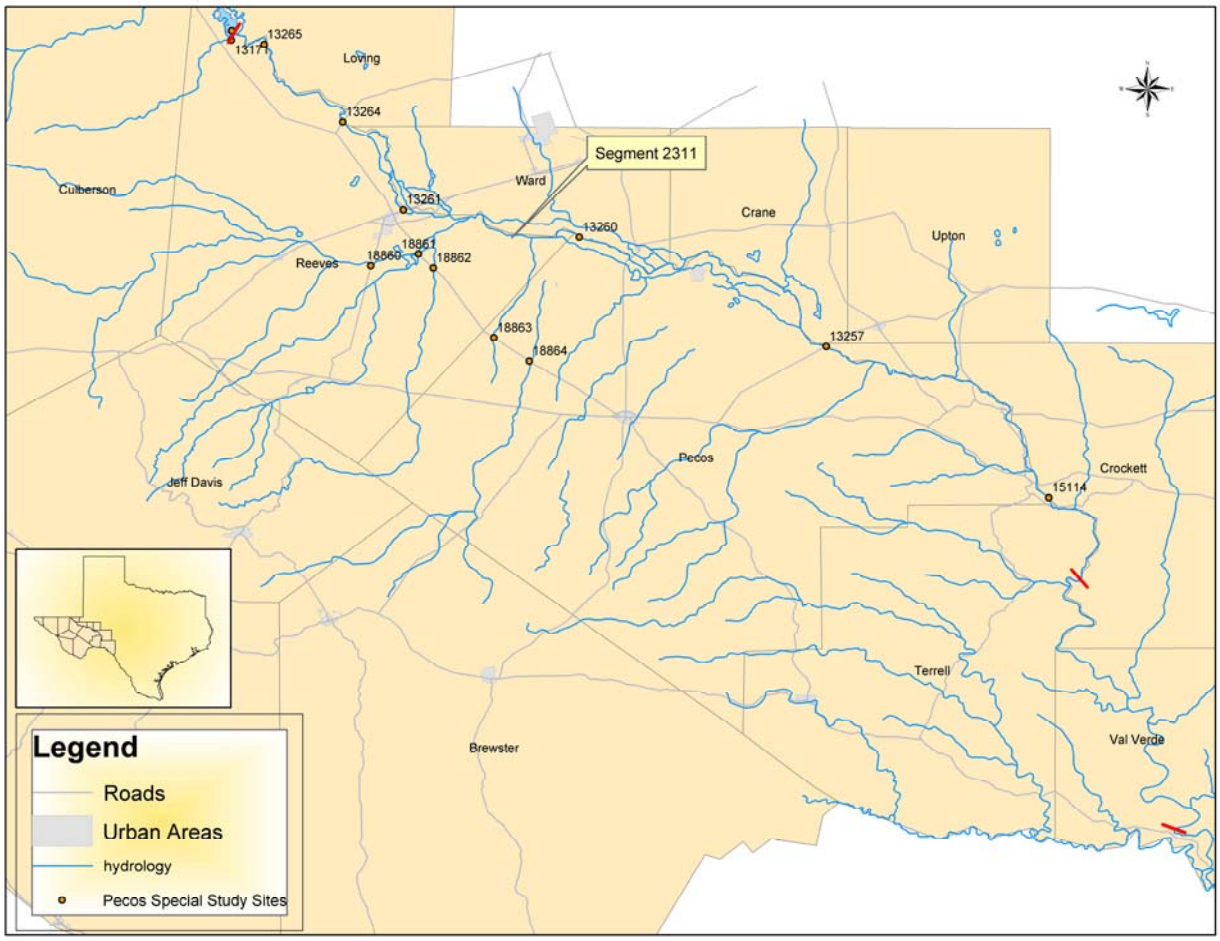

Figure 2. Locations of sampling sites in the Pecos River and tributaries.

Sampling Results

Water quality analysis results for tributary sampling events are listed in Appendix A. Salt Creek results show that the creek contains high levels of salt. Impacts of this tributary are discussed in *Reconnaissance Survey of Salt Sources and Loading in the Pecos River* by Dr. Seiichi Miyamoto done in conjunction with this project. In his report he noted that Salt Creek adds a significant amount of salt through surface water. Even when the creek does not reach the Pecos River it adds significant salt to the groundwater, which returns to the Pecos River below Pecos, TX through groundwater to surface water exchange. From Appendix A, the concentrations of salt anions and cations in Red Bluff were the same for both sampling events. The salinity value in the Pecos River rose only slightly below the confluence with Salt Creek below Red Bluff Reservoir during the July sampling event, but the river had values higher than Salt Creek during the March sampling event. The values for the salts in the Pecos River cannot climb higher than in Salt Creek regardless of the difference in volumes in the creek and the river; therefore, the addition of salts in the river may have come from another source such as highly saline groundwater intrusion into the river.

Sediment sample analysis results are listed in Appendix B. Results show that none of the tributaries possess high concentrations of salt, suggesting they have little affect on the salt loading in the Pecos River during high rain events with the exception of possibly Toyah Creek due to high sulfate content in the soil. Any impact, however, would be short lived and not be subject to a management plan. Further investigation is recommended at these sites to confirm this conclusion.

Historical data collected by the TCEQ in the late 1970's and in 1989 show a similar pattern as data collected in 2005 as is shown in Appendix C. Sodium and Potassium levels in the Pecos River from Red Bluff to Orla are not impacted by the confluence of Salt Creek values, which are substantially higher. From the data in 1989, we can also see that total dissolved solids and sodium values are also significantly lower than in Salt Creek. This data shows that the data collected 25 years later shows no change in the salt regime in the Pecos River and the lack of substantial impacts from the Salt Creek

Independence Creek has been continuously sampled by TCEQ for over 30 years and has consistently delivered high quality water at a constant volume. This creek beneficially impacts the Pecos River by adding significant volumes of freshwater into the river and reducing the concentration and loading of salt. Appendix D displays randomly selected water quality data to show this impact. The best management practice for the Independence Creek is preventing any change in the system. This is the same goal of The Nature Conservancy and the Chandler Family who have purchased the majority of the land around Independence Creek to prevent development and loss of stream flow to the Pecos River.

Discussions

Because of the arid environment that the Upper Pecos traverses, storm water pathways are rarely filled with water and based on the chemical composition of the soils in the streambed, it appears that there would be no significant negative impact on the water quality in the Pecos River. It is likely that perennial streams are creating a negative impact to the water quality of brackish groundwater that eventually impacts the upper Pecos River through groundwater springs. The actual effects and potential management practices applicable to the streams are outside the capacity of this study and would require intensive tracer and isotope analysis of the perennial tributaries to identify anion and cation migration. The result of this study suggest there are no direct surface impacts from the intermittent streams and no positive conclusions are reached regarding the impacts of the perennial streams on water quality in the upper Pecos River in Texas. Routine monitoring data on the lower Pecos River, Independence Creek, and in Amistad Lake shows that, in the Lower Pecos, perennial streams and springs introduce freshwater thereby reducing salt concentrations prior to the Pecos River entering Amistad Lake.

Acknowledgement
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References

Handbook of Texas Online, available at: http://www.tsha.utexas.edu/handbook/online/index.html last accessed April, 2007

Miyamoto, S., Yuan, F. and Anand, S., 2006, *Reconnaissance Survey of Salt Sources and Loading into the Pecos River*, TR- 291, Texas Water Resources Institute, Texas A&M University

Appendix A – Water Quality Analyses

Table 1. Red Bluff Water Quality Analyses

Sampling Event	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
3/08/2005	1490	1887	42	1411	5187
7/12/2005		1689		1336	5320

Table 2. Salt Creek Water Quality Analyses

Sampling Event	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
3/08/2005	4075	4311	51.3	1965	10711
7/12/2005	2181	5451	28.5	2966	14520

Table 3. Rio Grande at Orla Water Quality Analyses

Sampling Event	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
3/08/2005	4310	4914	80	2335	11358
7/12/2005	582.6	1764	18.7	1429	5430

Appendix B – Sediment Analysis

Table 4. Tributary Sediment Analyses

Site Location	Sodium (mg/kg)	Chloride (mg/kg)	Potassium (mg/kg)	Sulfate (mg/kg)	Nitrate (mg/kg)
Salt Draw 18860	371	13.8	6569	140	1.1
Toyah Creek 18861	899	42	4860	14109	7.5
Coyanosa Draw 18864	309	<5.0	5036	232	1.9
Barilla Draw 18862	418	<5.0	5502	39	1.7
Hackberry Draw 18863	412	<5.0	5527	44	3.8

Appendix C - Historical Water Quality Data

Table 5. Red Bluff Water Quality Analyses

Sampling Event	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
7/15/1976		2470		1480	
7/12/1977		3267		1600	
7/26/1978		3616		1750	
7/02/1979		2400		1450	
8/17/1989		1870		1800	

Table 6. Salt Creek Water Quality Analyses

Sampling Event	Flow (cfs)	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
7/27/1976	5		9630		3390	
7/12/1977	3.3		10164		3500	
7/26/1978	10		5282		2200	12220
7/02/1979	14		10000		3750	
10/24/1989	11	8154	12599	9	4688	27640

Table 7. Rio Grande at Orla Water Quality Analyses

Sampling Event	Flow (cfs)	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
7/27/1976	37		2830		1610	
7/12/1977			3902		1900	
7/26/1978	8					
7/02/1979			1650			
10/24/1989	60	604	2548	35	2127	7460

Appendix D - Water Quality Data from Independence Creek

Table 8. Pecos River above Independence Creek Water Quality Analyses

Sampling Event	Flow (cfs)	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
8/16/1995	72		1010		627	5860
5/21/1997	80		901		604	2390
4/5/2001	75		1600		928	3560
4/23/2002	65		1430		853	3980
4/13/2004	127	667	1080	10.5	637	2990

Table 9. Independence Creek Water Quality Analyses

Sampling Event	Flow (cfs)	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
7/25/1995	20		123		143	925
5/22/1997	20		101		152	712
4/5/2001	25		126		179	572
4/23/2002	20		125		176	772
4/13/2004	40	75.1	97	4.77	143	

Table 10. Pecos River below Independence Creek Water Quality Analyses

Sampling Event	Flow (cfs)	Sodium (mg/l)	Chloride (mg/l)	Potassium (mg/l)	Sulfate (mg/l)	TDS (mg/l)
8/16/1995	114	520	850	8.8	500	2310
5/29/1997	169		624		361	1664
4/4/2001	148	475	785	7.9	461	2124
4/22/2002	116	518	891	6.8	537	2377
4/13/2004	271		535	6.41	304	1570