2.0 UPPER RIO GRANDE (PART 2) BACKGROUND

For practical purposes, the Upper Rio Grande watershed was divided into two investigations (i.e., Parts 1 and 2). The Upper Rio Grande (Part 2) was intensively sampled by the New Mexico Environment Department/Surface Water Quality Bureau (NMED/SWQB) from May to October, 2001 and is addressed in this document. Surface water quality monitoring stations were selected to characterize water quality of the stream reaches (Table 2.1, Figure 2.1). Almost all of the perennial tributaries to the Rio Grande in New Mexico (NM) can be found within the Upper Rio Grande. The Rio Chama subwatershed and portions of the Santa Fe subwatershed were excluded from the 2001 investigation, because they were surveyed in separate studies.

As a result of the 2001 monitoring effort, exceedences of New Mexico water quality standards for turbidity were documented on Embudo Creek (Rio Grande to Canada de Ojo Sarco), the Rio Grande (non-pueblo Santa Clara to Embudo Creek), and Rio Santa Barbara (Picuris Pueblo bnd to USFS bnd). Exceedences of the chronic aluminum criterion were documented on Little Tesuque Creek (Rio Tesuque to headwaters) and conditions at Embudo Creek (Rio Grande to Canada de Ojo Sarco) were determined to be impaired due to sedimentation/siltation (i.e., did not meet the narrative stream bottom deposits standard).

During the development of this TMDL, it was noted that the assessment unit Rio Quemado (Santa Cruz River to headwaters) spanned two water quality standards. The assessment unit was split into Rio Quemado (Santa Cruz River to Rio Arriba Cnty bnd) NM-2118.A_52 and Rio Quemado (Rio Arriba Cnty bnd to headwaters) NM-2120.A_120 and reassessed. The 2001 sampling station was in the lower assessment unit, so this assessment unit should be listed for turbidity impairment based on the 2001 survey. The upper assessment unit should be noted as "Not Assessed" because there were no 2001 stations in this assessment unit. During November 2004, a sonde was deployed in the lower assessment unit to confirm the turbidity listing. There were only 6 of 216 exceedences of the turbidity criterion of 10 NTU. Based on assessment of the 2004 sonde data this assessment unit was delisted for turbidity.

Sonde data was also collected in November 2004 for the assessment units Tesuque Creek (Rio Tesuque to confl of forks) and Rio Chiquito (Picuris Pueblo bnd to headwaters). Both of these assessment units were originally included on the Integrated 2004-2006 CWA §303(d)/§305(b) list for turbidity impairments. The additional data collected in 2004 indicated these assessment units were meeting all of the designated uses, and therefore these assessment units were delisted for turbidity.

Additional impairments based on benthic macroinvertebrate bioassessments on other stream reaches (i.e., Rio Grande (non-pueblo Santa Clara to Embudo Creek); Embudo Creek (Canada de Ojo Sarco to Picuris Pueblo bnd); Rio Pueblo (Picuris Pueblo bnd to headwaters); and Rio Santa Barbara (Picuris Pueblo bnd to USFS bnd) and a sedimentation/siltation impairment for the Santa Cruz River (Santa Clara Pueblo to Santa Cruz Dam) were documented during the 2001 Upper Rio Grande Part 2 intensive study, but additional data is needed to determine the exact cause of these impairments and therefore will be discussed in future TMDLs. The impaired assessment units and TMDLs are summarized below.

2.1 Location Description and History

The Upper Rio Grande (Part 2) watershed (US Geological Survey [USGS] Hydrologic Unit Code [HUC] 13020101) is located in north central NM. The entire Upper Rio Grande watershed encompasses approximately 7,500 square miles (mi^2) and extends over portions of seven counties including Rio Arriba, Taos, Santa Fe, Los Alamos, Sandoval, Mora, and San Miguel. The Upper Rio Grande (Part 2) includes the geographic area draining into the Rio Grande between Cochiti Reservoir (approximately 31 river miles above Albuquerque, NM) and just north of Embudo Creek (approximately 87 river miles upstream of Albuquerque, NM), as well as tributaries that enter the Rio Grande in that reach.

Several land grants were established along the Upper Rio Grande and its tributaries because water for domestic and irrigation purposes was necessary to the early settlers. The establishment of land grants also protected Upper Rio Grande towns and Spanish missions from attack by nomadic tribes (Westphall 1983). Because the archives of NM were destroyed during the Pueblo Revolt, little information is available regarding land grants prior to 1680 (Ebright 1994). Several Spanish-Indian land grants within the Upper Rio Grande Part 2 watershed were signed in the late 1600s and were later confirmed by the United States government (DeBuys 1985). These land grants include the Picuris, San Juan, Santa Clara, San Ildefonso, Pojoaque, Nambe, and Tesuque Pueblos (Figure 2.1) which are still intact today. Additional Spanish land grants in the 1700s included the Santa Barbara (1796), Las Trampas (1751), Sebastian Martin (1712), Santa Cruz (1694-1706), Nuestra Senora del Rosaria San Fernando y Santiago (1754), Santa Domingo de Cundiyo (1743), Francisco Montes Vigil (1754), Juan de Gabaldon (1752), and Jacona (1702) (DeBuys 1985). The majority of these land grants are no longer in place because they were either sold or redistributed. Today, much of the land in the Upper Rio Grande Part 2 watershed is still used for agriculture and rangeland.

The geology of the Upper Rio Grande watershed consists of a complex distribution of Precambrian metamorphic rocks, Paleozoic sedimentary rocks and Tertiary volcanics (Table 2.2, Figure 2.1). Smaller deposits of intrusives, ash flows and unaltered igneous rocks are also present. The Upper Rio Grande river bisects the two distinct geologic areas. The area west of the Rio Grande mainly consists of late Quaternary to Tertiary basalts formed as a result of the Rio Grande Rift tectonic events. The Tertiary volcanics (mainly basalt flows) are interbedded with sands and gravels, which were deposited during periods of erosion between volcanic events. The Rio Grande River has incised a deep canyon through these basalt flows, which extends from the Colorado border to Velarde, NM. Immediately east of the Rio Grande recent alluvial deposits cover these basalt deposits. The source of this alluvial material is the Sangre de Cristo Mountains, which parallel the river in a north-south direction. The Sangre de Cristo mountains mainly consist of Precambrian metamorphic rocks (amphibolites, granite, gneiss, and mica schist) and granitic stocks. Dikes of rhyolite, monzonite porphyry, latite and andesite are also common. Not as common, but still notable, are the scattered deposits of Pennsylvanian sediments including conglomerates, sandstones, shales and limestones. This portion of the Sangre de Cristo range is highly mineralized and heavily mined, as a result.

As presented in Figure 2.2, land ownership for the Rio Grande (non-pueblo Santa Clara to Embudo Creek) watershed is 51% U.S. Forest Service (USFS), 18% private, 16% Bureau of Land Management (BLM), 8% Native Lands, and 7% State. Land use includes 55% forest, 37% rangeland, 5% agriculture, 1% barren tundra, 1% built-up land, and less than 1% water (Figure 2.3).

Three sampling stations were established in the assessment unit Rio Grande (non-pueblo Santa Clara to Embudo Creek) during the 2001 survey (Table 2.1, Figure 2.1). Surface water grab samples from all of the above stations were analyzed for a variety of chemical/physical parameters. The chemical data were collected, assessed, and summarized in a water quality survey report (NMED/SWQB 2004b). Data results from grab sampling will be uploaded to USEPA's STORET database. Based on the data from the 2001 survey a TMDL has been developed for the following impairment:

- ***Turbidity***: Rio Grande (non-pueblo Santa Clara to Embudo Creek)

Table 2.1 SWQB 2001 Upper Rio Grande (Part 2) Sampling Stations

Station	Latitude, decimal degrees	Longitude, decimal degrees	Elevation, feet	Station Location
1	35.7916667	-106.3513889	6860	Alamo Canyon above Ponderosa Trail Crossing
2	35.7750000	-106.3416667	6360	Capulin Creek
3	36.1709000	-105.7370000	7400	Chamisal Creek below Village of Chamisal
4	**36.2108330**	**-105.9130560**	**5873**	**Embudo Creek at Hwy 68 bridge near Dixon at USGS Gage**
5	**36.1969440**	**-105.7350030**	**7159**	**Embudo Creek below Santa Barbara/Pueblo confluence**
6	35.4033360	-106.0500310	6000	Galisteo Creek at Cathy Richardson property above Cerillos
7	35.4336530	-106.1215150	5668	Galisteo Creek at Hwy 14 near Cerillos
8	35.5291667	-105.8458333	—	Galisteo Creek at Jim Cumming's residence in Canoncito
9	35.3953350	-105.9434220	6026	Galisteo Creek in Galisteo
10	**35.7255600**	**-105.8866700**	**8000**	**Little Tesuque Creek at first crossing of Hyde Park Road (Hwy 475)**
11	**35.7419480**	**-105.8416700**	**8822**	**Little Tesuque Creek at Hyde Park Road above Hyde Park**
12	35.8279100	-106.1837900	6221	Mortandad below White Rock WWTP outfall
13	35.7694480	-105.8086160	9705	N Fork of Tesuque Creek above Hyde Park Road (Hwy 475)
14	35.8027810	-106.1922260	6611	Pajarito above Rio Grande
15	35.8909100	-106.0714600	5655	Pojoaque River at State Road 84D
16	35.8812300	-106.2354300	6473	Pueblo Canyon below Bayo WWTP outfall
17	36.1789000	-105.7030000	7500	Rio Chiquito near mouth
18	35.7856000	-105.8694000	8392	Rio Chupadero above summer homes
19	35.7884000	-105.8500000	8750	Rio Chupadero at Borrego Canyon
20	36.1014000	-105.3636000	7760	Rio del Pueblo 0.8 miles above Hwy 518/75 at USGS

Station	Latitude, decimal degrees	Longitude, decimal degrees	Elevation, feet	Station Location
				Gage 08277470
21	35.8205590	-105.8902810	7224	Rio en Medio at USFS boundary
22	35.9650000	-105.9038890	6500	Rio Frijoles above Rio Medio
23	36.2153000	-105.8970000	6500	Rio Grande above Embudo Creek
24	**36.0076150**	**-106.0721990**	**5584**	**Rio Grande above Espanola at Valdez Bridge**
25	**36.2055590**	**-105.9636150**	**5774**	**Rio Grande at Embudo Station**
26	**36.0661150**	**-106.0761150**	**5623**	**Rio Grande at Hwy 74 near San Juan Pueblo**
27	35.4441700	-106.4397270	5131	Rio Grande at San Felipe Pueblo (pueblo land, no AU)
28	35.6178970	-106.3234680	5229	Rio Grande at USGS gage below Cochiti Reservoir outlet
29	35.7846000	-106.2015000	6000	Rio Grande at USGS gage in White Rock Canyon (near Water Canyon)
30	36.0397000	-106.0880000	6000	Rio Grande below Rio Chama
31	36.3200000	-105.7538890	6076	Rio Grande below Rio Pueblo de Taos at USGS gage
32	35.9654000	-105.9040000	6500	Rio Medio above Santa Cruz River
33	35.8494480	-105.8963920	6863	Rio Nambe above Nambe Reservoir
34	36.2041667	-105.7250000	—	Rio Pueblo above Rio Santa Barbara
35	36.1986160	-105.7313930	7185	Rio Pueblo at Hwy 75 above Rio Santa Barbara
36	36.1545000	-105.5510000	8232	Rio Pueblo below Flechado campground, above Sipapu Ski Area
37	36.0666670	-105.9022220	6463	Rio Quemado near Chimayo
38	36.1152780	-105.6386110	8420	Rio Santa Barbara at Hodges Campground
39	**36.1972260**	**-105.7341700**	**7165**	**Rio Santa Barbara at mouth**
40	35.7891700	-106.2863930	6125	Rito Canon de los Frijoles below cave
41	35.7809000	-106.2730100	5873	Rito de los Frijoles above Upper Falls
42	35.7753000	-106.2684000	6079	Rito de los Frijoles at Bandelier Visitor Center
43	35.7941700	-106.2991710	7000	Rito de los Frijoles at Bridge ¾ miles above ceremonial cave
44	35.3855330	-105.9447150	6000	San Cristobal Creek at Hwy 41 south of Galisteo
45	35.9647260	-105.9038930	6453	Santa Cruz River at USGS gage 08291000
46	35.9647260	-105.9038930	6100	Santa Cruz River at Hwy 520 Bridge
47	35.7600040	-105.8113920	10500	Tesuque Creek (south fork) above Hyde Park Road (Hwy 475)
48	35.7708330	-105.9416670	7000	Tesuque Creek across from Tesuque Post Office
49	35.7388920	-105.9055600	7211	Tesuque Creek at USGS Gage 08302500 near Santa Fe
50	35.7402778	-105.9080556	7060	Tesuque Creek near Bishops Lodge
51	36.1308330	-105.7591670	7420	Trampas Creek above Hwy 76

Notes: Data from the sampling stations in bold were used to develop the TMDLs discussed in this document.

Table 2.2 Geologic Unit Definitions for the Upper Rio Grande (Part 2)

Geologic Unit Code	Definition
IP	Pennsylvanian (age) rocks
MD	Mississippian and Devonian rocks, undivided; includes the Lake Valley Limestone
pC	Precambrian
Q_{al}	Alluvium; upper and middle Quaternary
Q_b	Quaternary Basalt and andesite flows and locally vent deposits
QT_b	Basaltic and andesitic volcanics interbedded with Pleistocene and Pliocene sedimentary units
QT_p	Older piedmont alluvial deposits and shallow basin fill
QT_s	Upper Santa Fe Group
T_p	Tertiary pediment deposit
T_{pi}	Tertiary (age) pyroclastic and intrusive rocks (volcanic rocks of varying compositions)

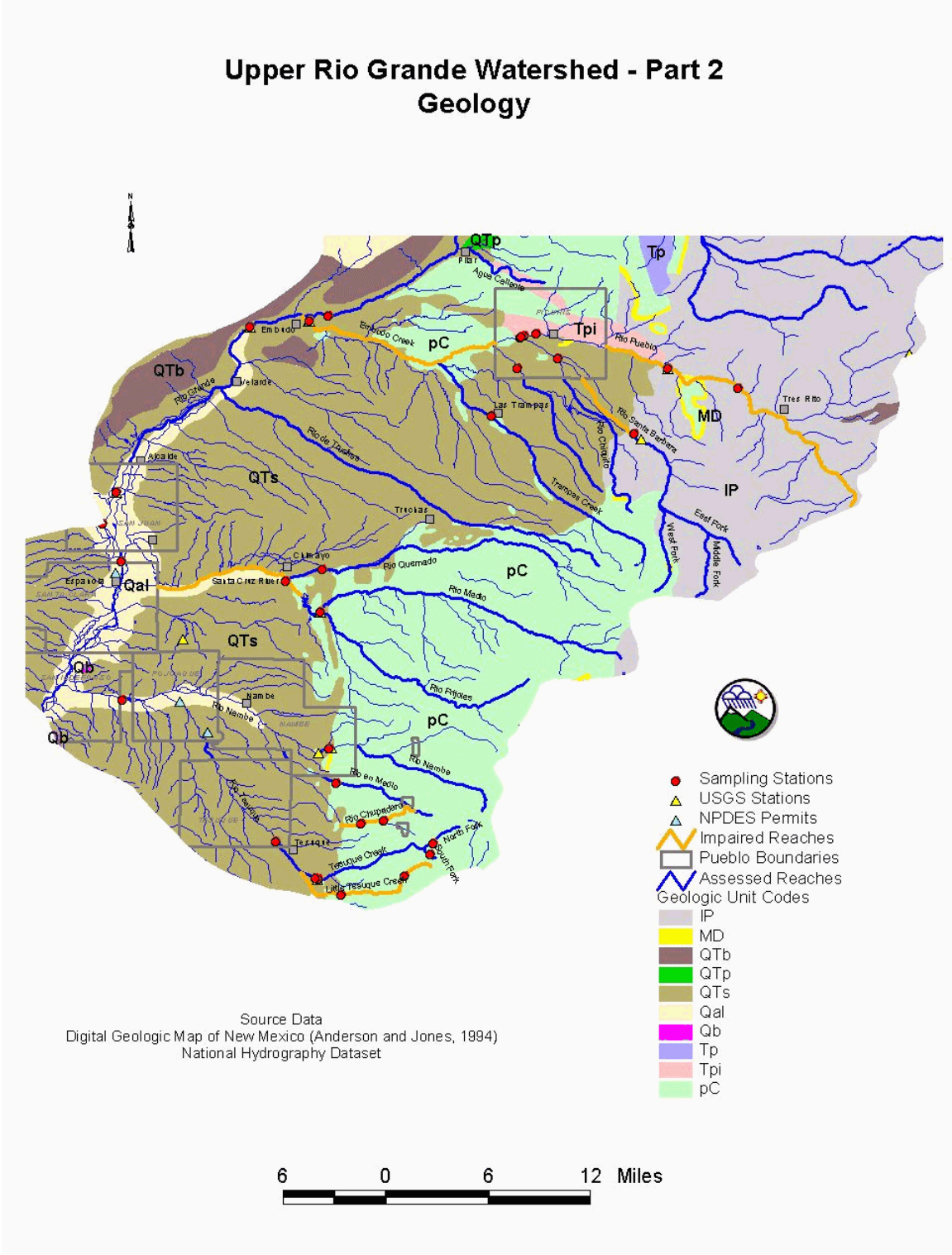

Figure 2.1 Upper Rio Grande (Part 2) Geology

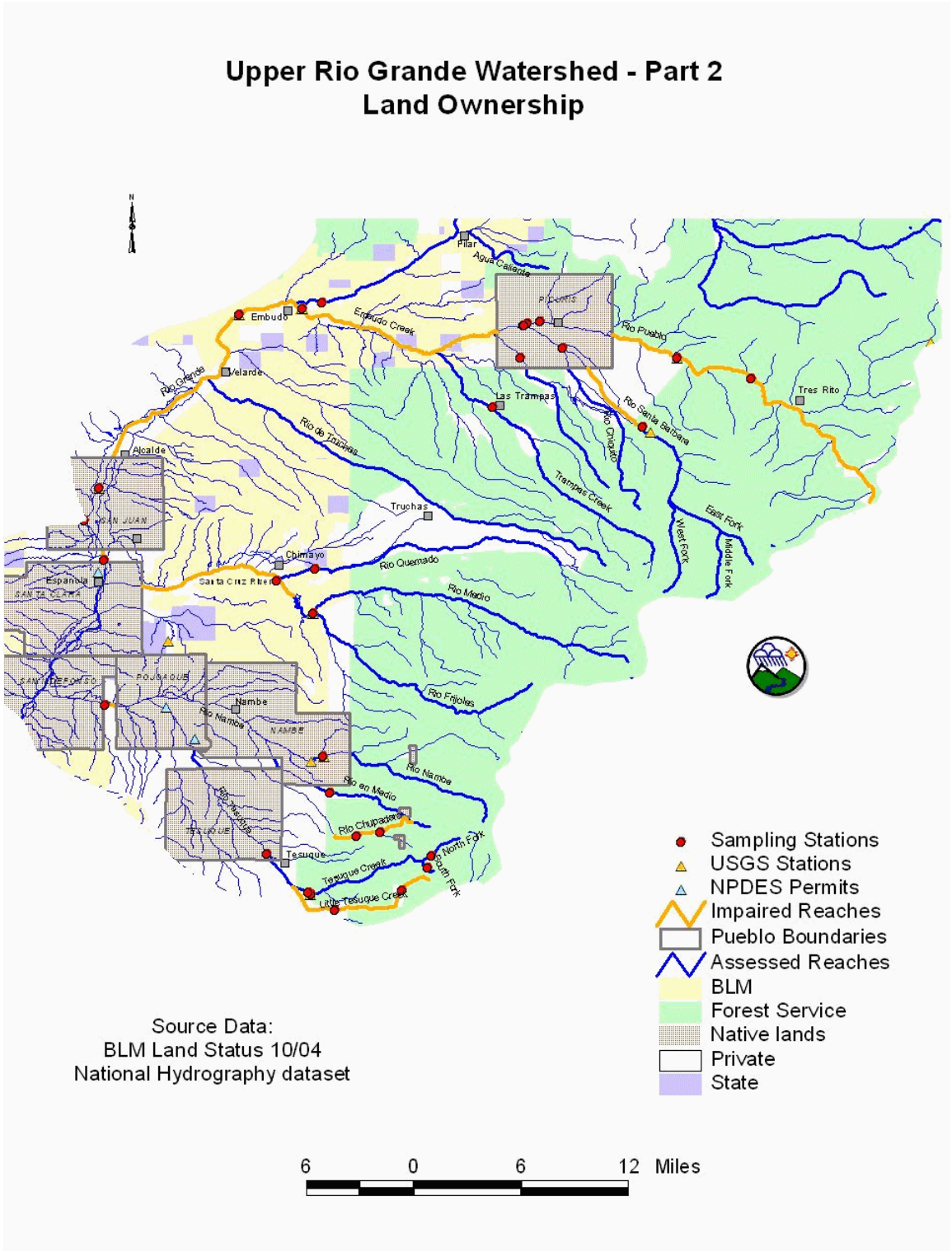

Figure 2.2 Upper Rio Grande (Part 2) Land Ownership and Sampling Stations

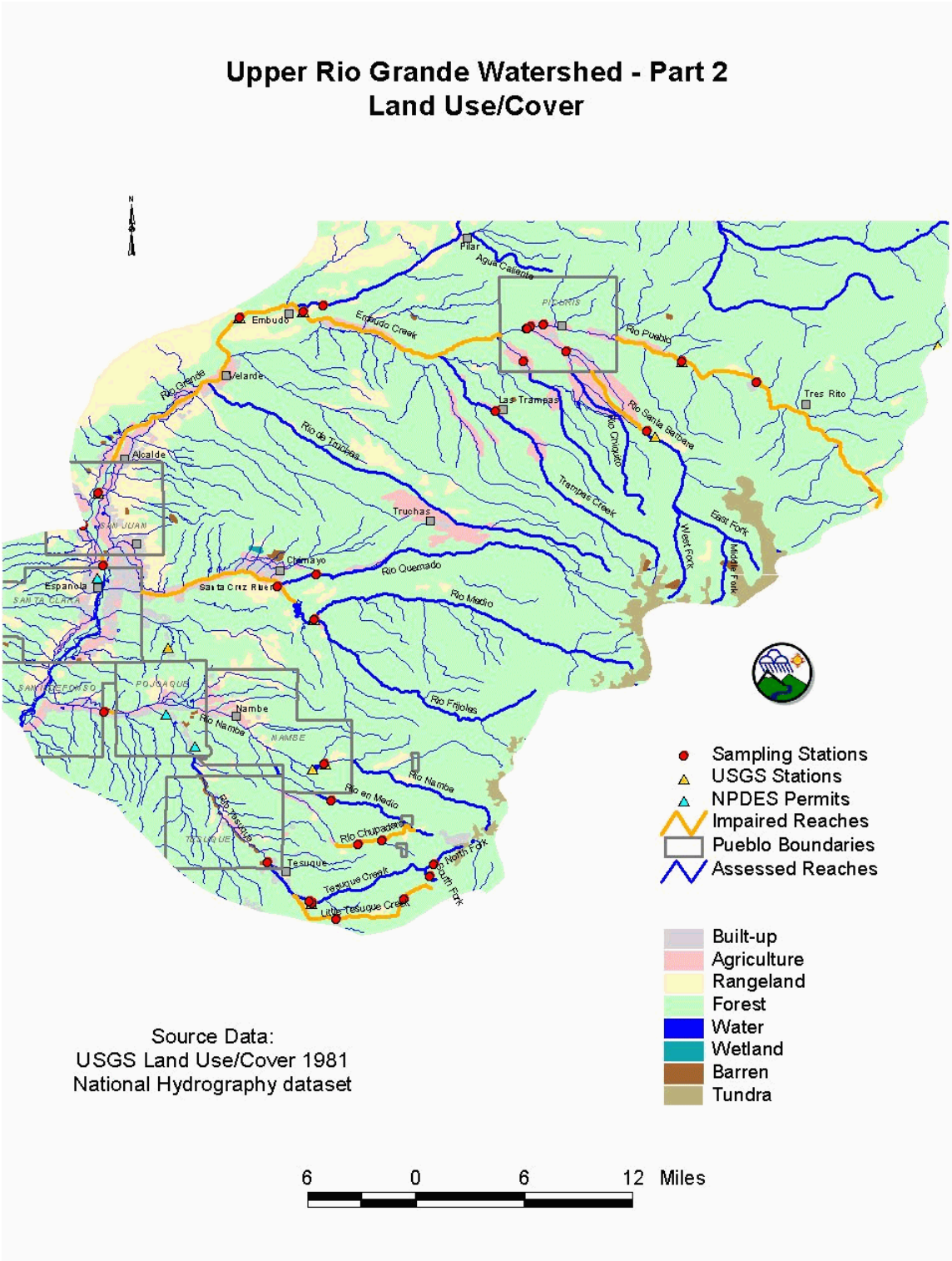

Figure 2.3 Upper Rio Grande (Part 2) Land Use/Cover and Sampling Stations

2.2 Water Quality Standards

Water quality standards (WQS) for all assessment units in this document are set forth in sections 20.6.4.114, 20.6.4.121, and 20.6.4.123 of the 2002 NM Standards for Interstate and Intrastate Surface Waters (NM Administrative Code [NMAC] 20.6.4). NMAC 20.6.4.114 reads as follows:

> **RIO GRANDE BASIN -** The main stem of the Rio Grande from the headwaters of Cochiti reservoir upstream to Taos Junction bridge, Embudo creek from its mouth on the Rio Grande upstream to the junction of the Rio Pueblo and the Rio Santa Barbara, the Santa Cruz river below Santa Cruz dam, the Rio Tesuque below the Santa Fe national forest and the Pojoaque river below Nambe dam.
>
> **A. Designated Uses**: irrigation, livestock watering, wildlife habitat, marginal coldwater fishery, primary contact, and warmwater fishery.
>
> **B. Standards**:
>
> (1) In any single sample: pH shall be within the range of 6.6 to 9.0, temperature shall not exceed 22°C (71.6°F), and turbidity shall not exceed 50 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.
>
> (2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL (see Subsection B of 20.6.4.13 NMAC).
>
> (3) At mean monthly flows above 100 cfs, the monthly average concentration for: TDS shall not exceed 500 mg/L, sulfate shall not exceed 150 mg/L, and chloride shall not exceed 25 mg/L.

NMAC 20.6.4.121 reads as follows:

> **RIO GRANDE BASIN -** Perennial tributaries to the Rio Grande in Bandelier national monument and their headwaters in Sandoval county, all perennial reaches of tributaries to the Rio Grande in Santa Fe county unless included in other segments.
>
> **A. Designated Uses**: domestic water supply, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply, secondary contact, and primary contact.
>
> **B. Standards**:
>
> (1) In any single sample: conductivity shall not exceed 300 µmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed l0 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.
>
> (2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

NMAC 20.6.4.123 reads as follows:

> **RIO GRANDE BASIN -** The Red river upstream of the mouth of Placer creek, all tributaries to the Red river, and all other perennial reaches of tributaries to the Rio Grande in Taos and Rio Arriba counties unless included in other segments.
> **A. Designated Uses**: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.
> **B. Standards**:
> (1) In any single sample: conductivity shall not exceed 400 µmhos (500 µmhos for the Rio Fernando de Taos), pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.
> (2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

NMAC 20.6.4.900 provides standards applicable to attainable or designated uses unless otherwise specified in 20.6.4.101 through 20.6.4.899. NMAC 20.6.4.12 lists general standards that apply to all surface waters of the state at all times, unless a specified standard is provided elsewhere in NMAC.

2.3 Intensive Water Quality Sampling

The Upper Rio Grande (Part 2) watershed was intensively sampled by the NMED/SWQB in 2001. A brief summary of the survey and the hydrologic conditions during the sampling events is provided in the following subsections.

2.3.1 Survey Design

Water quality samples were collected during three seasons (spring, summer, and fall) in 2001. Surface water quality monitoring stations were selected to characterize water quality of the stream reaches. Table 2.1 and Figure 2.1 present the SWQB water quality monitoring station locations sampled in 2001 in the portion of the Upper Rio Grande between the Pojoaque River and north of Embudo Creek. Stations were located to evaluate the impact of tributary streams and to determine ambient water quality conditions. The results of the entire Upper Rio Grande (Part 2) survey were summarized in a water quality survey report (NMED/SWQB 2004b).

All sampling and assessment techniques are detailed in the *Quality Assurance Project Plan* (QAPP, NMED/SWQB 2001) and the SWQB assessment protocols (NMED/SWQB 2004). As a result of the 2001 monitoring effort, several exceedences of NM WQS for several streams were documented. Accordingly, these impairments were added to NM's 2004-2006 CWA §303 (d) list (NMED/SWQB 2004c).

2.3.2 Hydrologic Conditions

There are two USGS gaging stations in the Upper Rio Grande (Part 2) watershed associated with the reaches presented in this document. USGS gage locations are presented in Figure 2.1. Daily streamflows for these USGS gages are presented graphically in Figures 2.3 and 2.4 for the 2001 calendar year.

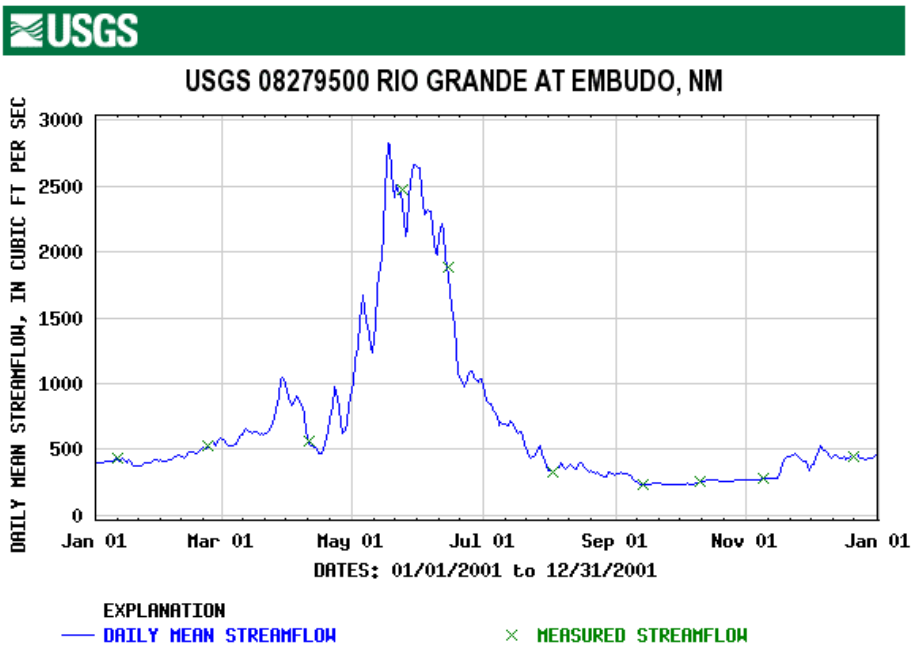

Figure 2.4 USGS Average Daily Streamflow, Rio Grande at Embudo, NM (2001)

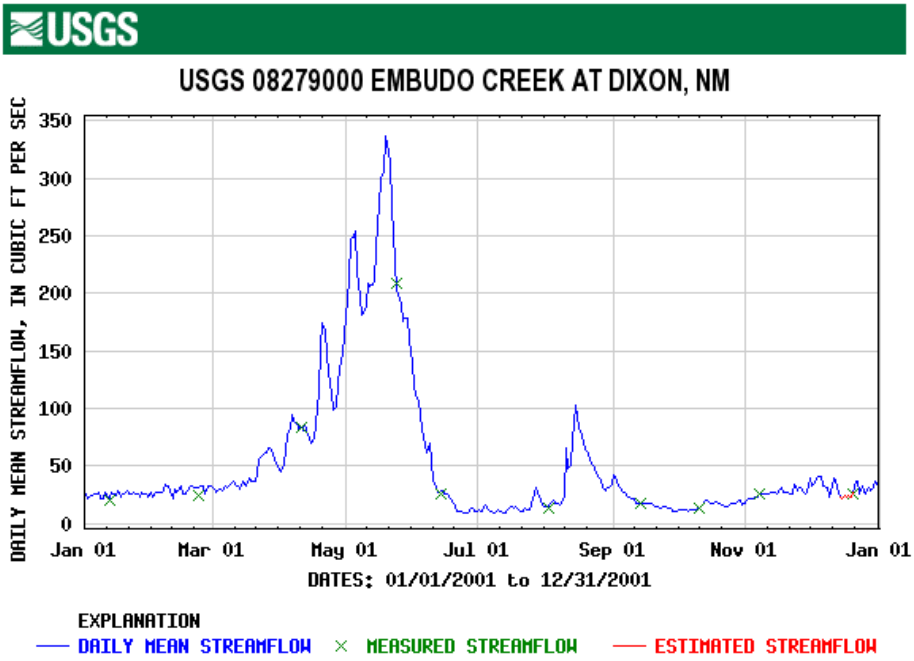

Figure 2.5 USGS Average Daily Streamflow, Embudo Creek at Dixon, NM (2001)