2.0 RIO PUERCO WATERSHED BACKGROUND

2.1 Description and Land Ownership

The Río Puerco Watershed covers approximately 4,736 square miles (mi²) in northwestern New Mexico (NM). The impaired reach covered by this TMDL, Río Puerco (Arroyo Chijuilla to northern boundary Cuba), drains approximately 138 mi². Land use for the watershed includes 62% forest, 21% shrubland, 12% grassland, 4% agriculture, and less than 1% developed, water, wetlands, bare rock, and mines/quarries (Figure 2.1). As presented in Figure 2.2, land ownership for the Río Puerco watershed is 38% U.S. Forest Service (USFS), 37% private, 10% Bureau of Land Management (BLM), 14% Native Lands, and <1% State.

The Río Puerco is the largest tributary to the middle Río Grande Basin and has headwaters located in the Nacimiento Mountains east of Cuba, NM. The mainstem of the Río Puerco begins in a wetland on the southwest side of San Pedro Peak. This mountain range is fully contained within the San Pedro Peak Wilderness area of the Santa Fe National Forest. From its 10,500-foot beginning, the stream flows to the southwest for almost 7 miles through high elevation forests then into a series of wet meadows to the edge of the wilderness area at 8,500-foot elevation.

From the forest boundary downstream approximately 6 miles to the Village of Cuba, domestic and wildlife grazing, road construction, and maintenance activities on private and public lands have impacted riparian vegetation and initiated discontinuous stream channel incision. In some local segments the stream bed is now five to ten feet below its original floodplain, while adjacent reaches remain relatively stable. At and below the Village of Cuba, flows from a series of small streams draining the west face of the Sierra Nacimiento Range on the Santa Fe National Forest combine with effluent from the Cuba WWTP to provide perennial flow in the Río Puerco downstream towards the confluence with Arroyo Chijuilla. This reach of the Río Puerco as well as the downstream reach flows through a complex mixture of private, State and Federal lands in a wide, deeply incised, vertical-walled canyon with banks up to 35 feet high. Erosional processes within this reach of the stream are extensive. Significant landscape and channel erosion, and channel incision are unfortunate realities throughout the majority of the Río Puerco Watershed. When these conditions occur, soil is lost, the landscape is vulnerable to sheet attrition and rilling, vegetation vigor declines, streams and tributaries become sediment-filled, the availability of accessible water for irrigation diversions decreases or disappears, the river beds are lowered, the banks extended, riparian resources and related habitat is impacted, water quality deteriorates, and this process is inevitably accompanied by a drop in the local water table. None of these resulting conditions are conducive to healthy land productivity. Photos 2.1 and 2.2 provide a general visual overview of the area and show the extent to which portions of the watershed have experienced erosion and cut banks.

In the mid-1960s a segment of the reach between La Ventana and Cuba was diverted from its original meandering channel into a straight channel on the west side of the highway during the original construction of this valley segment of State Highway 44. This channelization has
resulted in an estimated 14.1 million cubic feet of sediment erosion of the local river bed and
banks (Coleman, et al. 1998), has put the highway at risk, and has destroyed several County
roads and bridges. In 1999, the multi-agency process of widening the highway to four lanes and
transitioning it to federal Highway 550 also committed to restore the Río Puerco to its original
channel and initiate riparian restoration efforts. These restoration activities, along with many
other upstream and downstream projects, are ongoing and demonstrate favorable potential to
improve water quality in the Río Puerco and Río Grande.

Photo 2.1 Historic photo of Río Puerco near Cabezòn (Bureau of Reclamation Collection)
Water quality in the Río Puerco has long been of concern both within and outside of the State of NM. It has been known for over forty years that the Río Puerco contributes only a tiny fraction of the Río Grande’s total water volume yet contributes well over half of the total sediment load entering Elephant Butte Reservoir (Happ 1948).

### 2.2 Geology and Fluvial Geomorphology

The Río Puerco Basin includes ten large subwatersheds draining portions of eight counties, west of the greater Río Grande Basin, in the northwest and west central portion of NM. Encompassing approximately 4,736 mi², it is by far the largest in-state tributary to the Río Grande.

The watershed lies along the east-southeast margin of the Colorado Plateau, along a transition zone with the Río Grande Rift (Basin and Range Province). Soft upper Paleozoic, Mesozoic, and lower Cenozoic sedimentary strata dominantly characterize the geologic setting of the area, displaying Permian through Tertiary age continental and marine sandstones, shales, mudstones, and carbonate rocks. Strata are generally flat lying, often faulted, and carved into broad valleys flanked by mesas and mountains. The mountainous areas along the margins of the northeast and west-central watershed are made up of intrusive igneous rocks (granitic plutonic rocks, gneiss, and schists). Younger Tertiary or Quaternary volcanic rocks intrude the sediments and occasionally cap high standing mesas. Tertiary and Quaternary valley fill, pediment gravels, talus, and alluvial deposits mantle the geologic section.

Numerous geomorphic elements combine to form the watershed’s present structural, fluvial, and topographic settings. Existing landforms are an indication of the large amounts of surface...
materials that have been removed from the region by wind and water. Elevations range from the 11,301 foot peak of Mt. Taylor, to the terrain at 10,500 feet in the Sierra Nacimiento - San Pedro Parks Wilderness headwaters area, to 9,120 feet along the Continental Divide in the Zuni Mountains, to less than 4,700 feet at the lower Río Puerco / Río Grande confluence at Bernardo north of Socorro. The change in elevation, a rather high regional surface gradient, and an excess of straight drainage channel segments combines with the region’s climatic setting and vulnerable sedimentary lithologies to exacerbate the watershed’s well-documented reputation for dramatic erosion.

Average rainfall in the basin varies annually between 12-20 inches, delivered mostly by late summer monsoon thunderstorms creating violent flash flood runoff that sweeps out of well-vegetated highlands across sparsely vegetated slopes and valley surfaces, carrying thin topsoil and weathered bedrock away. The large aerial extent of erosive geologic units provides the abundant source of available sediment, estimated as 40% from existing channels and banks, 30% from sediment-producing tributary drainages, and 30% from sheet, rill, and minor gully erosion of adjacent uplands (Gellis, 1992).

Soil loss contributing to sediment loading is such an extreme problem throughout the watershed that the basin has earned its status as one of the nation's most actively eroding watersheds. In fact, when compared with some of the world’s great river systems, the Río Puerco Basin has been documented to transport one of the highest known average annual sediment concentrations. As the major source of suspended sediment entering the Río Grande above Elephant Butte Reservoir, the Río Puerco was determined to be contributing 83% of the total sediment load from 1948 to 1973 and 60% of the total load between 1974 and 1996. That decrease over time is evident in recent data from three active United States Geological Survey (USGS) gage stations in the lower half of the watershed. Investigators indicate that the decrease may be due to evolving changes in channel and planform geometry, combined with a decrease in peak flows out of the watershed, both favoring vegetation increases that positively influence channel roughness, sediment deposition, and overall stabilization. It is also believed that successful upland and in-channel erosion-control strategies implemented by private land owners prior to government-lead efforts, and by state and federal watershed restoration programs working with land management agencies and private landowners have contributed to this upward trend.

The distribution of soils and vegetation is also strongly influenced by topography and geology. Digitally processed satellite images show many parts of the basin are very responsive to seasonal variations in precipitation, while scattered riparian corridors in main stem and tributary drainages are recognized as increasingly stable and less prone to displaying significant vegetation changes given annual or seasonal precipitation variation. Natural vs. human controls on vegetation distribution aid in assessing impacts of grazing and other concentrated land use practices on erosion and sediment production.

The headwaters source area of the upper Río Puerco gathers snow melt and summer showers from forested terrain and meadows at the crest of the Nacimiento Uplift, approximately twelve miles above the Village of Cuba. Relatively low-discharge perennial tributaries coalesce and drop off the western face of the Nacimiento (one of the most prominent linear fault scarps in the southwest) as mostly straight and steep bedrock, boulder, or large cobble-lined channels. The
foothills areas north and northeast of Cuba are composed of erodible sedimentary units (clay and mudstones), so while stream incision becomes a component of this drainage system very close to its headwaters area, the downstream reach’s sand-dominated setting and decreased gradient allows for some recovery of stable channel dimension, pattern, and profile.

The least incised, best vegetated, and most stable segment occurs one to three miles upstream of the Village of Cuba, below which deep incision and a broad meandering pattern becomes characteristic across the wide flat valleys, on to the distant confluence with the Río Grande. A few discontinuous bedrock zones or recent manmade grade control structures are occasionally observed controlling the incision.
Figure 2.1 Río Puerco Watershed Land Use/Land Cover and Sampling Stations
Figure 2.2 Río Puerco Watershed Land Ownership and Sampling Stations
Figure 2.3 Río Puerco Watershed Geology
2.3 Water Quality Standards

Water quality standards (WQS) for the Río Puerco are set forth in the following sections of *New Mexico Standards for Interstate and Intrastate Surface Waters* (NM Administrative Code [NMAC] 20.6.4) (NMAC 2005):

**20.6.4.105**  **RIO GRANDE BASIN** – The main stem of the Río Grande from the headwaters of Elephant Butte reservoir upstream to Alameda Bridge (Corrales-bridge) and intermittent water below the perennial reaches of the Río Puerco that enters the main stem of the Río Grande.

A. **Designated Uses:** irrigation, marginal warmwater aquatic life, livestock watering, wildlife habitat, and secondary contact.

B. **Criteria:**
   1. In any single sample: pH within the range of 6.6 to 9.0 and temperature 32.2°C (90°F) or less. The use-specific criteria 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 E. coli bacteria 126 cfu/100 mL or less; single sample 410 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).
   3. At mean monthly flows above 100 cfs, the monthly average concentration for: TDS 1,500 mg/L or less, sulfate 500 mg/L or less and chloride 250 mg/L or less.

**20.6.4.109**  **RIO GRANDE BASIN** – Perennial reaches of Bluewater creek, Río Moquino, Seboyeta creek, Río Paguate, the Río Puerco above the village of Cuba and all other perennial reaches of tributaries to the Río Puerco including the Río San Jose in Cibola county from the USGS gaging station at Correo upstream to Horace springs.

A. **Designated Uses:** coldwater aquatic life, domestic water supply, fish culture, irrigation, livestock watering, wildlife habitat, and primary contact.

B. **Criteria:**
   1. In any single sample: pH shall be within the range of 6.6 to 8.8, temperature 20°C (68°F) or less and total phosphorus (as P) 0.1 mg/L. The use-specific criteria 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 E. coli bacteria 126 cfu/100 mL or less; single sample 235 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

The assessment unit Río Puerco (Arroyo Chijuilla to northern boundary Cuba) does not fall into either of the specific Río Puerco standards listed above. This is a perennial reach of the Río Puerco within and below the Village of Cuba and therefore is not covered in 20.6.4.109 which only applies to perennial reaches of the Río Puerco above the Village of Cuba. In addition 20.6.4.105 does not apply because it relates to intermittent portions of the Río Puerco below perennial portions. Since neither of these standards apply to this particular reach of the Río Puerco, the general perennial waters standard (20.6.4.99) with an existing use of marginal
warmwater aquatic life will be the applicable standard for this TMDL document.

20.6.4.99  **PERENNIAL WATERS** – All perennial surface waters of the state that are not included in a classified water of the state in 20.6.4.101 through 20.6.4.899 NMAC.

A.  **Designated Uses**: aquatic life, livestock watering, wildlife habitat, and secondary contact.

B.  **Criteria**:

   1. Temperature shall not exceed 34°C (93.2°F). The use-specific criteria 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 E. coli bacteria shall not exceed 548 cfu/100 mL; no single sample shall exceed 2507 cfu/100 mL (see Subsection B of 20.6.4.14 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 20.6.4.13 lists general standards that apply to all surface waters of the state at all times, unless a specified standard is provided elsewhere in NMAC.

### 2.4 Intensive Water Quality Sampling

The Río Puerco watershed was intensively sampled by the SWQB in 2004. A brief summary of the survey and the hydrologic conditions during the intensive sample period is provided in the following subsections. A more detailed description of the Río Puerco intensive survey can be found in the *Water Quality Survey Summary for the Río Puerco and Tributaries* this document will be available online Fall 2006 at [http://www.nmenv.state.nm.us/swqb/MAS/index.html](http://www.nmenv.state.nm.us/swqb/MAS/index.html) (NMED/SWQB 2006a). Survey summary reports are also available via a phone call to SWQB.

#### 2.4.1 Survey Design

Surface water quality samples were collected monthly between March and November during the 2004 intensive SWQB study. Surface water quality monitoring stations were selected to characterize water quality of various assessment units (i.e., stream reaches) throughout the watershed (Table 2.1, Figures 2.1 through 2.3). Stations were located to evaluate the impact of tributary streams and to determine ambient and background water quality conditions. Surface water grab samples were analyzed for a variety of chemical/physical parameters. Data from grab samples and field measurements are housed in the SWQB provisional water quality database and were uploaded to USEPA’s Storage and Retrieval (STORET) database.
Table 2.1 SWQB 2004 Río Puerco Sampling Stations

<table>
<thead>
<tr>
<th>Assessment Unit</th>
<th>STORET ID</th>
<th>Station Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluewater Creek (Bluewater reservoir to headwaters)</td>
<td>36Bluewa018.9</td>
<td>Bluewater Creek above Bluewater Lake @ USGS Gage 8341300</td>
</tr>
<tr>
<td>Bluewater Creek (non-tribal Rio San Jose to Bluewater Rsrv)</td>
<td>36Bluewa003.5</td>
<td>Bluewater Creek @ mouth of Bluewater cayon</td>
</tr>
<tr>
<td>Rio Moquino (Laguna Pueblo to Seboyettia Creek)</td>
<td>36RMoqui006.4.6</td>
<td>Rito Moquino below confl of Seboyettia Creek and Seboveta Creek</td>
</tr>
<tr>
<td>Rio San Jose (Horrace Springs to Grants WWTP)</td>
<td>N/A</td>
<td>Rio San Jose blw Grants WWTF Discharge¹</td>
</tr>
<tr>
<td>La Jara Creek (Perennial reaches abv Arroyo San Jose)</td>
<td>33LaJara009.7</td>
<td>La Jara Creek abv irrigation diversion</td>
</tr>
<tr>
<td>Arroyo San Jose (Río Puerco to La Jara Creek)</td>
<td>33ASanJo006.5</td>
<td>Arroyo San Jose @ Hwy 550</td>
</tr>
<tr>
<td>Rito de los Pinos (Perennial reaches abv Arroyo San Jose)</td>
<td>33RPinos006.8</td>
<td>Rito de los Pinos @ USFS gate on FR 95</td>
</tr>
<tr>
<td>Rito Leche (Perennial reaches above Río Puerco)</td>
<td>33RLечение002.6</td>
<td>Rito Leche @ Hwy 126</td>
</tr>
<tr>
<td>Rito Leche (Perennial reaches above Río Puerco)</td>
<td>33RLечение001.3</td>
<td>Rito Leche @ Cubita Rd</td>
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<tr>
<td>Nacimiento Creek (Río Puerco to USFS bnd)</td>
<td>33Nacimi008.0</td>
<td>Nacimiento Creek @ Eureka Rd</td>
</tr>
<tr>
<td>Nacimiento Creek (Río Puerco to USFS bnd)</td>
<td>33 Nacimiento003.4</td>
<td>Nacimiento Creek @ Hwy 126</td>
</tr>
<tr>
<td>Senorito Creek (Perennial Reaches above San Pablo Canyon)</td>
<td>33Senor006.8</td>
<td>Senorite Creek b1w Nacimiento Mine</td>
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<tr>
<td>San Miguel Arroyo (San Pablo Canyon to headwaters)</td>
<td>33SanMig005.7</td>
<td>San Miguel Arroyo @ old Hwy 44</td>
</tr>
<tr>
<td>San Pablo Canyon (Río Puerco to headwaters)</td>
<td>33SPablo000.2</td>
<td>San Pablo Canyon abv Río Puerco</td>
</tr>
<tr>
<td>Río Puerco (northern bnd Cuba to headwaters)</td>
<td>33RPuerc256.0</td>
<td>Río Puerco @ CR 13</td>
</tr>
<tr>
<td>Río Puerco (Arroyo Chijuilla to northern bnd Cuba)</td>
<td>33RPuerc248.7</td>
<td>Río Puerco @ Hwy 550</td>
</tr>
<tr>
<td>Río Puerco (Arroyo Chijuilla to northern bnd Cuba)</td>
<td>33RPuerc244.0</td>
<td>Río Puerco abv WWTP</td>
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<tr>
<td>Río Puerco (Arroyo Chijuilla to northern bnd Cuba)</td>
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<td>Río Puerco blw WWTP @ Sanchez Property</td>
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<tr>
<td>Río Puerco (non-pueblo Río Grande to Arroyo Chijuilla)</td>
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<td>Río Puerco abv La Ventana Restoration Project</td>
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<tr>
<td>Río Puerco (non-pueblo Río Grande to Arroyo Chijuilla)</td>
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<td>Río Puerco blw La Ventana Restoration Project</td>
</tr>
<tr>
<td>Río Puerco (non-pueblo Río Grande to Arroyo Chijuilla)</td>
<td>33RPuerc198.4</td>
<td>Río Puerco @ Hwy 279 Bridge near San Luis</td>
</tr>
<tr>
<td>Río Puerco (non-pueblo Río Grande to Arroyo Chijuilla)</td>
<td>33RPuerc004.6</td>
<td>Río Puerco @ I-25</td>
</tr>
</tbody>
</table>

¹No data collected, only photographs. Grants WWTP went to land application and channel now dry all year.

All sampling and assessment techniques used during the 2004 intensive SWQB survey are detailed in the Quality Assurance Project Plan (QAPP) (NMED/SWQB 2004b) and assessment
protocols (NMED/SWQB 2006b) both of which are available online or via a phone call to SWQB. As a result of the 2004 SWQB monitoring effort, several surface water impairments were verified. Accordingly, these impairments will remain and several new determined impairments will be added to the 2006-2008 Integrated CWA §303 (d)/305(b) list (NMED/SWQB 2006c in progress).

2.4.2 Hydrologic Conditions

There are no active real-time USGS gaging stations in the Río Puerco watershed associated with the reaches presented in this document. However, available flow data are included in Appendix D.

The 2004 SWQB intensive survey was performed over varying flow conditions from March to November. Flows during the 2004 survey year were below average based on the period of record. As stated in the Assessment Protocol (NMED/SWQB 2006b), data collected during all flow conditions, including low flow conditions (i.e., flows below the 4-day, 3-year low flow frequency [4Q3]), will be used to determine designated use attainment status during the assessment process. In terms of assessing designated use attainment in ambient surface waters, WQS apply at all times under all flow conditions.