3.0 SEDIMENTATION/SILTATION (STREAM BOTTOM DEPOSITS)

Based on sampling performed in the Fall of 2004, impairment due to excessive sedimentation/siltation (previously listed as impairment due to Stream Bottom Deposits [SBD]) was confirmed for Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba). This assessment unit was originally listed on the 1996-1998 Integrated CWA §303(d)/§305(b) list for SBD (NMED/SWQB 1996) under the assessment unit name of Río Puerco (Rito Olguin to headwaters). This original assessment unit was later split based on the SWQB's knowledge of geologic conditions and stream characteristics of the Río Puerco.

3.1 Target Loading Capacity

Target values for this Sedimentation/Siltation TMDL will be determined based on 1) the presence of numeric criteria or appropriate numeric translator to a narrative standard, 2) the degree of experience in applying the indicator, and 3) the ability to easily monitor and produce quantifiable and reproducible results. This TMDL is also consistent with New Mexico's antidegradation policy.

The state of New Mexico has developed and adopted a narrative "bottom deposit" standard. The current general narrative standard for the deposition of material on the bottom of a stream channel is specifically found in Section 20.6.4.13(A) of the State of New Mexico Standards for Interstate and Intrastate Surface Waters (NMAC 2002):

> ***Bottom Deposits****: Surface waters of the State shall be free of water contaminants from other than natural causes that will settle and damage or impair the normal growth, function, or reproduction of aquatic life or significantly alter the physical or chemical properties of the bottom.*

Clean stream bottom substrates are essential for optimum habitat for many fish and aquatic insect communities. The impact of fine sediment deposits is well documented in the literature. Impairment occurs when critical habitat components, such as spawning gravels and cobble surfaces, are physically covered by fines thereby decreasing intergravel oxygen and reducing or eliminating the quality and quantity of habitat for fish, macroinvertebrates, and algae (Chapman and McLeod 1987, Lisle 1989, Waters 1995). An increased sediment load is often the most important adverse effect of activities on streams, according to a monitoring guidelines report (USEPA 1991). This impact is largely a mechanical action that severely reduces the available habitat for macroinvertebrates and fish species that utilize the streambed in various life stages. Minshall (1984) cited the importance of substratum size to aquatic insects and found that substratum is a primary factor influencing the abundance and distribution of insects. Aquatic detritivores also can be affected when their food supply either is buried under sediments or diluted by increased inorganic sediment load and by increasing search time for food (Relyea et al. 2000). In addition, sediment loads that exceed a river's sediment transport capacity often trigger changes in stream morphology (Leopold and Wolman 1964). Streams that become

overwhelmed with sediment often go through a period of accelerated channel widening and streambank erosion before returning to a stable form (Schumm 1977, Knighton 1984). These morphological changes tend to accelerate erosion, thereby reducing habitat diversity and placing additional stress on designated aquatic life uses.

The SWQB Sediment Workgroup evaluated a number of methods described in the literature that would provide information allowing a direct assessment of the impacts to the stream bottom substrate. In order to address the narrative criteria for bottom deposits, SWQB compiled techniques to measure the level of sedimentation of a stream bottom. These procedures are presented in Appendix D of the *State of New Mexico Procedures for Assessing Standards Attainment for the Integrated §303(d)/§305(b) Water Quality Monitoring and Assessment Report* (NMED/SWQB 2006b). The purpose of the protocol is to provide a reproducible quantification of the narrative criteria for bottom deposits in small wadeable streams. A final set of monitoring procedures was implemented at a wide variety of sites during the 2001 monitoring season. These procedures included conducting pebble counts (to determine percent fines), stream bottom cobble embeddedness, geomorphologic measurements, and the collection and enumeration of benthic macroinvertebrates. The SWQB is in the process of reviewing the sedimentation assessment protocol in order to improve it in the future, and will solicit input on revisions and improvements to this protocol.

The target levels involved the examination of developed relationships between percent fines and biological score as compared to a reference site. Using existing data from New Mexico, a relationship (r^2=0.75) was established between embeddedness and the biological scores using data collected in 1998 (NMED/SWQB 2006b). A correlation (r^2= 0.719) was also found when relating embeddedness to percent fines. Although these correlations were based on a limited data set, TMDL studies on other reaches, including those in the Cimarron Basin, the Jemez Basin, and the Río Guadalupe, have shown these relationships to be consistent. These relationships show that at the desired biological score of at least 79, the target embeddedness for fully supporting a designated use would be 45% and the target percent fines would be 20% (NMED/SWQB 2006b). Since this relationship is based on New Mexico streams, 20% was utilized for the target value for percent fines in previous TMDLs for small wadeable streams in New Mexico.

Rio Hondo above Rio Grande was chosen as the benthic macroinvertebrate reference station for the Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba). Benthic macroinvertebrate samples and pebble counts were collected at both stations (Barbour et al. 1999, Wohlman 1954). Due to the extremely unique geomorphic characteristics and the level of impairment of the Río Puerco, it is difficult to identify an ideal benthic macroinvertebrate reference location for the Río Puerco. According to the SWQB assessment protocols (NMED/SWQB 2006b), a site can be used as a “best available” reference location if the reference and study site have similar attributes such as elevation, geology, and hydrology (precipitation, etc.). Both the Rio Puerco and Rio Hondo stations are in Omernik Ecoregion 22 and have similar geomorphic characteristics (Table 3.1).

Collection of benthic macroinvertebrates was performed using two devices, a kick net and a surber sampler. Use of the kick net involved the disturbance of approximately 0.5 of a square

meter of substrate for one minute. Three individual kick net samples were taken from a riffle at each sampling location and composited into a single sample. The second method involved using a Surber Sampler to collect three replicate samples from a riffle at each sampling location. In an area approximately 0.3 square meter, each substrate particle larger than 2 inches was scrubbed to remove macroinvertebrates and removed. The fines were then manually agitated to suspend any remaining macroinvertebrates. During both processes, the sampler was embedded in the substrate with the net opening facing upstream after which the substrate upstream of the sampler was disturbed. The macroinvertebrates dislodged during the disturbance are washed into a 500-micron mesh net. The rapid bioassessment protocol (RBP) metrics were applied to a 300-organism subsample of the composite sample at each site (Barbour et al. 1999). Selection of those metrics that are particularly suited to the delineation of sediment impacts highlights the degree of impairment. Ephemeroptera/Plecoptera/Tricoptera (EPT) taxa, the number of sediment adapted organisms, taxa richness, and Hilsenhoff's Biotic Index (HBI) all indicate some degree of impairment attributable to sedimentation (Table 3.1). Select results of the pebble count and benthic macroinvertebrate surveys are shown in Table 3.2.

Table 3.1 Characteristics of Benthic Macroinvertebrate Sampling Sites

Characteristics	Reference Site[(a)]	Study Site[(b)]
Omernik Level III Ecoregion	22	22
Aquatic Ecoregion*	2	2
Elevation	6453 ft (1967 m)	6900 ft (2103 m)
Watershed Area (square miles)	74	18

*Cowely *et al.* (1997) Aquatic Ecoregion 2 defines areas between 1675 m and 2135 m.

Table 3.2 Pebble Count and Benthic Macroinvertebrate Results

Results	Reference Site[(a)]	Study Site[(b)]	Percent of Reference
Pebble count			
% Fines (< 2 mm)	29%	68%	134%
D50	56 mm	0.6 mm	—
D84	325 mm	4 mm	—
Benthic metrics			
Ephemeroptera/ Plecoptera/ Tricoptera Taxa	12	4	—
Taxa Richness	33	31	—
Hilsenhoff's Biotic Index	4.7	6.78	—
Total Biologic Score (out of a possible 48)	44	18	41%
Total Habitat Score (out of a possible 200)	173	85	49%

Notes:
[(a)] Reference Site = Rio Hondo abv Rio Grande
[(b)] Study Site = Río Puerco @ Hwy 550 Bridge
mm = Millimeters — = Not applicable

3.2 Flow

No streamflow data are necessary because all loads are specified in percent fines.

3.3 Calculations

No calculations were necessary because all loads are specified in percent fines. The target loads for sedimentation are shown in Table 3.3.

Table 3.3 Calculation of Target Loads for Sedimentation/Siltation

Location	Sedimentation Standard[(a)] (% fines)	Sedimentation Target Load Capacity (% fines)
Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	20	20

Notes:

(a) This value is based on a narrative standard. The background values for bottom deposits were taken from the Stream Bottom Deposit Assessment Protocol (NMED/SWQB 2006b).

The target load capacity of 20% fines is a statewide target that has been used in previous TMDLs for small wadeable streams in New Mexico. The target for the Rio Puerco and other parts of the state will be refined over time as the sedimentation assessment protocol is revised and improved. A 5 to 20% decrease in sediment in the assessment unit could be considered environmentally beneficial. It is important to remember that the TMDL itself is a value calculated at a defined critical condition, and is calculated as part of planning process designed to achieve WQSs. Since flows vary throughout the year in these systems, the actual load at any given time will vary based on the changing flow. Management of the load to improve stream water quality should be a goal to be attained.

Measured load was determined by a pebble count as described in the Stream Bottom Deposit Assessment Protocol (NMED/SWQB 2006b). Fines are defined as particles less than 2 millimeters (mm) in diameter. Results are displayed in Table 3.4.

Table 3.4 Calculation of Measured Loads for Sedimentation/Siltation

Location	Sedimentation/ Siltation Measured Load (% fines)
Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	68

3.4 Waste Load Allocations and Load Allocations

3.4.1 Waste Load Allocation

The Village of Cuba Wastewater Treatment Plant (WWTP) (NM0024848) is located within the impaired Río Puerco AU and discharges directly to the Río Puerco. There is some debate regarding whether or not total suspended solids (TSS) from wastewater facilities has an impact on sedimentation. TSS sampling in ambient streams typically measures suspended sediment from erosional processes. Since TSS sampling in WWTP effluent typically measures biosolids, which are less inclined to settle on the stream bottom, USEPA contends that TSS from WWTPs have no impact on sedimentation.

There are no Municipal Separate Storm Sewer System (MS4) storm water permits in this AU. Sediment may be a component of some industrial and construction storm water discharges covered under General Permits, so these discharges should be addressed. In contrast to discharges from other industrial storm water and individual process wastewater permitted facilities, storm water discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the NPDES construction general storm water permit (CGP) for construction sites greater than one acre requires preparation of a Storm Water Pollution Prevention Plan (SWPPP) that includes identification and control of all pollutants associated with the construction activities to minimize impacts to water quality. In addition, the current CGP also includes state specific requirements to implement best management practices (BMPs) that are designed to prevent to the maximum extent practicable, an increase in sediment, or a parameter that addresses sediment (e.g., TSS, turbidity, siltation, SBDs, etc.) and water velocity during and after construction compared to pre-construction conditions. In this case, compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Other industrial storm water facilities are generally covered under the current NPDES Multi Sector General Storm Water Permit (MSGP). This permit also requires preparation of an SWPPP that includes identification and control of all pollutants associated with the industrial activities to minimize impacts to water quality. In addition, the current MSGP also includes state specific requirements to further limit (or eliminate) pollutant loading to water quality impaired/water quality limited waters from facilities where there is a reasonable potential to contain pollutants for which the receiving water is impaired. In this case, compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

Individual wasteload allocations for the General Permits were not possible to calculate at this time in this watershed using available tools. Loads that are in compliance with the General Permits from facilities covered are therefore currently calculated as part of the watershed load allocation.

3.4.2 Load Allocation

In order to calculate the LA, the WLA and MOS were subtracted from the target capacity TMDL following **Equation 1**:

$$WLA + LA + MOS = TMDL \qquad \text{(Eq. 1)}$$

The MOS is estimated to be 20 percent of the target load calculated in Table 3.3. Results are presented in Table 3.5. Additional details on the MOS chosen are presented in Section 3.7.

Table 3.5 TMDL for Sedimentation/Siltation

Location	WLA (% fines)	LA (% fines)	MOS (20%) (% fines)	TMDL (% fines)
Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	0	16	4.0	20

The extensive data collection and analyses necessary to determine background sedimentation loads for this AU was beyond the resources available for this study. It is acknowledged that the natural geology of the Rio Puerco watershed contributes to the sediment load in the impaired reach. Therefore, it is assumed that portions of both the load allocation and the measured load will necessarily include sediment contributed by natural background sources.

It is important to reiterate that TMDLs are planning documents that provide a framework for working towards the goal of achieving water quality standards or appropriate numeric translators. Management of the load to improve stream water quality is a goal to be attained, rather than a regulatory requirement.

3.5 Identification and Description of Pollutant Source(s)

Probable nonpoint sources that may be contributing to the observed load are displayed in Table 3.6:

Table 3.6 Pollutant source summary for Sedimentation/Siltation

Pollutant Sources	Magnitude[(a)]	Location	Probable Sources[(b)]
Point:			
None	0%	--------	0%
Nonpoint:			
Sedimentation	68%	Río Puerco (Arroyo Chijuilla to Northern boundary of Cuba)	100% Highway/Road/Bridge Runoff (non-construction related) Loss of Riparian Habitat Rangeland Grazing Streambank Modification/destabilization Channelization Natural Sources Wildlife other than Waterfowl Drought-related Impacts

Notes:
(a) Measured Load expressed as % fines.
(b) From the 2004-2006 Integrated CWA 303(d)/305(b) list (NMED/SWQB 2004a). This list of probable sources is based on staff observation and known land use activities in the watershed. These sources are not confirmed or quantified at this time.

Probable sources of sedimentation for this assessment unit will be evaluated, refined, and changed as necessary through the Watershed Restoration Action Strategy (WRAS) process.

3.6 Linkage of Water Quality and Pollutant Sources

SWQB fieldwork includes an assessment of the potential sources of impairment. The Pollutant Source(s) Documentation Summary included in Appendix A provides documentation of a visual analysis of probable sources along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of potential sources of impairment in this watershed. Staff completing these forms identify probable sources of nonpoint source impairments along each reach as determined by field reconnaissance and assessment. It is important to consider not only the land directly adjacent to the stream, which is predominantly privately held, but also to consider upland and upstream areas in a more holistic watershed approach to implementing these TMDLs.

New Mexico's existing bottom deposits narrative WQS includes the phrase " …*from other than natural causes*…" Therefore, the degree to which sediment delivery and transport in this watershed is a natural phenomenon, has been exacerbated by human activities, or is the result of a combination of both should be considered. Even though the highly erodible soils of the Río Puerco Watershed are the primary source of sediment transport, the anthropogenic influence of the highway construction, channelization, land development, and historical rangeland grazing

practices are contributing to impairment in the Río Puerco. The geology in the watershed contributes to the amount of sediment available for transport.

3.7 Margin of Safety

TMDLs should reflect a MOS based on the uncertainty or variability in the data, the point and nonpoint source load estimates, and the modeling analysis. For this TMDL, there will be no MOS for point sources since none were accounted for in the TMDL calculation. However, the MOS is estimated to be 20% for sedimentation. This MOS is based on the uncertainty in the relationship between embeddedness and percent fines. In this case, the percent fines numeric target was determined to interpret the narrative standard. There are also potential errors in measurement of nonpoint source and background loads due to sampling technique, time of sampling, and other factors. Accordingly, a conservative MOS for sedimentation accounts for **20%** of the TMDL.

3.8 Consideration of Seasonal Variation

Data used in the calculation of this TMDL were collected during the fall, which is a biological index period; meaning fall is a critical time in the life cycle stages of aquatic biota. Fall is also generally the low-flow period of the mean annual hydrograph in New Mexico when bottom deposits are most likely to settle and cause impairment, after the summer monsoon season but before annual spring runoff. It is assumed that if critical conditions are met during this time, coverage of any potential seasonal variation will also be met.

3.9 Future Growth

Estimations of future growth are not anticipated to lead to a significant increase for sedimentation that cannot be controlled with BMP implementation in the watershed, continued improvement of road conditions, and proper land management.