

The Rio Santa Barbara Watershed-Based Plan

This is a watershed-based plan to address a water quality problem identified by the State of New Mexico in a portion of the Rio Santa Barbara. The watershed planning elements published by the Environmental Protection Agency in the Federal Register on October 23, 2003¹ are used as a guide for focusing on this purpose. The stream segment of concern is the Rio Santa Barbara downstream of the Carson National Forest, excluding portions on Picuris Pueblo, and is identified by NMED as “Rio Santa Barbara (Picuris Pueblo bnd to USFS bnd)”, with assessment unit identification number NM-2120.A_419.

This portion of the Rio Santa Barbara lies wholly within a watershed referred to by USGS as “Outlet Rio Santa Barbara”, with hydrologic unit code 130201010905. This sixth-code watershed also contains part of an upstream segment of the Rio Santa Barbara (USFS boundary to confluence of East and West Forks, AU NM-2120.A_420) which is not presently thought to be impaired. Another sixth code watershed upstream, called “Headwaters Rio Santa Barbara” (HUC 130201010904) contains several assessment units within the Pecos Wilderness which were designated by the New Mexico Water Quality Control Commission (WQCC) in 2005 as Outstanding Natural Resource Waters, and are thought to be relatively pristine.

The lower Rio Santa Barbara watershed (130201010905) is identified as a priority for both watershed planning and water quality improvement activities in the New Mexico Nonpoint Source Management Program². The upper watershed (130201010904) is included in this planning effort because sources of pollutants affecting the lower Rio Santa Barbara may exist within the upper watershed.

This section was drafted by staff of the New Mexico Environment Department Surface Water Quality Bureau, and input was solicited from the La Jicarita Watershed and Wastewater Study Committee, the Pueblo of Picuris, Taos County Public Works Department, Taos Soil and Water Conservation District, Santa Barbara Grazing Association, Rio Chiquito Grazing Association, and Carson National Forest (the Supervisor’s Office and the Camino Real Ranger District). Review and input were solicited over a period of several months with formal letters requesting review, and parallel emails and phone calls, and similar follow-up correspondence. The La Jicarita Watershed and Wastewater Study Committee, Taos County Public Works Department, Taos Soil and Water Conservation District, Santa Barbara and Rio Chiquito Grazing Associations, and Carson National Forest (the Supervisor’s Office and the Camino Real Ranger District) reviewed the document and provided some input. Other key stakeholders may provide input to a later draft as time and priorities permit.

¹ The *Nonpoint Source Program and Grants Guidelines for States and Territories* are available on line at frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2003_register&docid=fr23oc03-39.pdf.

² The New Mexico Nonpoint Source Management Program planning document is available on line at www.nmenv.state.nm.us/SWQB/WPS/Plan/index.html.

All reviewers who provided input felt that the plan has merit and that the quantitative aspects represent an improvement over the earlier effort. Reviewers generally are looking forward to implementation of specific components of interest to them. Carson National Forest staff felt that the load reduction estimates for pollutant sources and management measures would benefit from a more technical analysis with input from more natural resources professionals and a larger group of watershed residents.

Causes of Impairment

One of the designated uses of the Rio Santa Barbara, recognized in New Mexico's water quality standards, is high quality coldwater aquatic life. The State of New Mexico recognized in 2004 that high quality coldwater aquatic life is not fully supported in the Rio Santa Barbara downstream of the Carson National Forest, and turbidity is a cause of that impairment³.

The WQCC approved a total maximum daily load (TMDL) for turbidity in January 2005, and EPA approved it in June 2005⁴. The TMDL establishes a goal for pollutant load reduction (called the target load reduction in the TMDL) of 1,503 pounds per day of total suspended solids. Because there are no permitted point sources in the Rio Santa Barbara watershed, this load reduction goal can be met only by addressing nonpoint sources of pollution or other pollution occurring in the absence of discharge permits.

Sources of Pollutants

The TMDL does not establish maximum acceptable loads for individual sources or source activities of nonpoint source pollution, and nor does it establish quantitative load reduction goals for them.

The data used for the initial assessment and subsequent TMDL were collected by the NMED Surface Water Quality Bureau (SWQB) from a site on the Rio Santa Barbara on Picuris Pueblo land, near its confluence with the Rio Pueblo (STORET code URG120.022001), in a water quality survey conducted in 2001⁵. This site was sampled eight times during the survey, and the data were considered representative of the subject reach of the Rio Santa Barbara. Two of eight turbidity measurements exceeded the water quality criterion (25 NTU) in place at that time. The two exceedences occurred on consecutive days in August, recently following characteristic summer thundershowers.

Additional relevant data were collected from the Rio Chiquito, a small tributary of the Rio Santa Barbara, which was sampled on three dates in 2001 near its confluence with

³ Recognition of impairment is documented in the *2004-2006 State of New Mexico Integrated Clean Water Act §303(D)/§305(B) Report*, available on line at www.nmenv.state.nm.us/wqcc/303d-305b/2004/index.html.

⁴ The TMDL is available on line at www.nmenv.state.nm.us/SWQB/Projects/RioGrande/Upper/TMDL2/index.html.

⁵ A report of the survey is available on line at www.nmenv.state.nm.us/swqb/Surveys/UpperRioGrandePartII-2001.pdf.

the Rio Santa Barbara. Relatively turbid water (in excess of the water quality criterion) was observed in the Rio Chiquito on one date in May (during peak snowmelt), and on August 14 when the Rio Santa Barbara was also quite turbid. During the August sampling, SWQB staff observed turbid water draining from the road into the stream, but the Rio Chiquito was also turbid upstream of that point.

More relevant data were collected during the 2001 survey from the Rio Santa Barbara (USFS boundary to confluence of East and West forks) near Hodges Campground (STORET code URG120.022023). This site is near the lower end of the assessment unit on Carson National Forest land. There were no exceedences of water quality standards among the eight data points available, although the data can be used to estimate background conditions for the Rio Santa Barbara entering the impaired reach. Though low, levels of total suspended solids at the Hodges Campground may conceivably be elevated by a road leading up the canyon from there and by other minor watershed disturbances and land use activities including grazing. Specialist reports prepared by Forest Service staff (and available upon request) on various aspects of management of the upper watershed may assist with further defining pollutant sources in this area.

Two meetings were conducted in Vadito in July 2008 with watershed residents to collect and document information about pollutant sources and the most promising solutions. The membership of the La Jicarita Watershed and Wastewater Study Committee was invited, and each meeting was attended by approximately six watershed residents. The meetings were dedicated exclusively to discussions of the impaired reach of the Rio Santa Barbara. SWQB staff developed a spreadsheet which was projected onto the wall to help facilitate discussions of pollutant sources. The spreadsheet consisted of three tables presented below. One table focused on geographic source areas, one table focused on source activities, and one table identified appropriate practices to reduce pollutant loading. Participants were asked to evaluate different source areas, source activities, or management changes relative to one another in terms of percent, and formulas were used to calculate corresponding load reductions.

Suggested portions of the watershed, source activities, and management practices were entered into the tables prior to the meetings, but participants were able to change these to reflect their understanding of the watershed and of likely pollutant sources. The participants iteratively specified values such that the load reductions were appropriately sized relative to one another, and such that the sum of load reductions would equal the target load reduction in the TMDL, and they compared the results in different tables to ensure that the rationale for entering a specific value in one table was reflected in the other tables. This exercise often resulted in participants changing their minds, and by the end of the second meeting a consensus developed that the tables were populated in a way that reasonably reflects reality.

Table 1: Sources of suspended sediment in the Rio Santa Barbara, by geography

Geographic Area	Percent	Load (lb TSS / day)	Notes
Background at Hodges (upper end of reach)	5	75.15	Hodges TSS concentration was 29% of RSB at mouth TSS concentration (n=5)
Loading between Hodges and Rodarte	15	225.45	
Loading from Rodarte through Peñasco (including Peñasco, but excluding the Rio Chiquito watershed)	45	676.35	
Rio Chiquito watershed (includes a portion of Peñasco)	20	300.6	Chiquito concentration was 253% of RSB at mouth concentration (n=2)
Loading from Peñasco to Rio Lucio	15	225.45	
Totals	100%	1503	

Table 2: Sources of suspended sediment in the Rio Santa Barbara, by source activity

Source Activity	Percent	Load (lb TSS / day)	Notes
Accelerated runoff from ponderosa and mixed conifer forest	5	75.15	
Accelerated runoff from Piñon/Juniper forest	10	150.3	
Off-road vehicles	8	120.24	
Runoff from unpaved roads including driveways	50	751.5	County maintained and unmaintained roads
Runoff from pastures and hayfields	20	300.6	
Accelerated bank erosion	5	75.15	
Ojitos and esteros	0		organic matter in water, oily film on top. Part of background.
Rio Chiquito gravel pit	2	30.06	
Totals	100%	1503	

Management Measures

Ponderosa Pine Forest Restoration

As noted in Table 2, a small amount of preventable loading that contributes to the impairment of the lower Rio Santa Barbara is thought to originate from degraded ponderosa pine forest. Most ponderosa pine forest lies within the watershed of the upper Rio Santa Barbara (HUC 130201010904), and most of that is at middle elevations within the Carson National Forest (where the stream meets its water quality standards). Ponderosa pine forest restoration may include thinning, prescribed burning, and use of

prescribed natural fire⁶. The hydrologic basis of forest restoration as a practice to improve water quality hinges on observations that understory vegetation, which prevents soil erosion and promotes infiltration, is often thicker in a more natural (*i.e.*, open) ponderosa pine forest. This activity has more promise as a method to protect water quality (and other watershed resources and values) than to improve water quality. A relatively minor portion of ponderosa pine forest acreage is within the Pecos Wilderness, where active restoration methods such as thinning is limited by Wilderness Act protections. The ability of a forest floor to carry low intensity fire is affected by grazing management, which is a separate category of management measure.

In 2001, the Carson National Forest conducted NEPA analysis for the Santa Barbara Watershed Restoration project, which has since only been partially implemented. The project would thin 500 acres of mixed conifer woodland, burn 5000 acres with prescribed fire, develop a prescribed natural fire plan, restore one wetland, and close and obliterate approximately two miles of spur roads in the watersheds of the Río Santa Barbara, Río Pueblo, and Río Chiquito.

USFS Grazing BMPs

Grazing best management practices on Carson National Forest land are stipulated in Allotment Management Plans and Annual Operating Instructions developed by the Forest Service, in cooperation with permittees, and with public input through the NEPA process. These activities apply to all Carson National Forest lands, which in this watershed lie primarily within the ponderosa pine forest and above, including within the Pecos Wilderness. Most of the relevant acreage is within the Santa Barbara Allotment (which is primarily within the upper Rio Santa Barbara watershed), followed by the Rio Chiquito Allotment, which comprises significant acreage in the upper Rio Chiquito watershed (and 30% of HUC 130201010905). The Carson National Forest has conducted significant analysis of grazing management options in these allotments⁷. Planned grazing BMPs related to water quality include use of herding and salting to achieve better distribution of livestock, proper timing and intensity of grazing (supported by monitoring), compliance with grazing schedules, construction of drift fences, and construction of hiking stiles to prevent gates from being left open, and construction of holding pens and corrals to assist with livestock gathering. Generally, permittees are required to maintain fences and other range improvements specified in Allotment Management Plans, and must share the costs for these practices with the Forest Service or, possibly in cooperation with the Forest or other organizations, seek funding for them.

Piñon/Juniper Forest Restoration

Piñon/juniper forests within the Rio Santa Barbara watershed lie at lower altitudes, and are roughly evenly divided between USFS management and private ownership. Because these forests occur at lower, drier elevations, the intercanopy areas are generally more barren and erosive than the ponderosa pine forest floor, and thus are thought to contribute

⁶ For more information, see Allen, *et al.*, *Ecological Applications*, 12(5), 2002, pp. 1418–1433. This article is available on line at www.biologicaldiversity.org/publications/papers/Allen-Restoration-2002.pdf.

⁷ Several related documents are available on line at www.fs.fed.us/r3/carson/natural_resources/range/camino_real/2009/2009_camino_real.shtml.

more fine sediment to the river and present more opportunities for load reduction than do ponderosa pine forests. Restoration approaches in piñon/juniper forest are similar to those of ponderosa pine, but are more controversial because less is known about the natural fire regime, and because the fire regime is thought to be much more intense (more likely endangering infrastructure)⁸. For these reasons, firewood harvest is considered a practical means of reducing competition of piñon and juniper with intercanopy grasses and forbs. The most practical means of implementing significant firewood harvest in the context of restoration is for the agency (USFS) to pay applicants a small amount to cut all but marked trees within small stewardship plots. In exchange for cutting unmarketable small trees, the applicant may remove whatever product he or she deems useful, such as firewood, fenceposts, latillas, etc. In more remote locations (*e.g.*, away from roads), this approach is not as practical, and thinning of piñon or juniper trees under larger contracts without firewood harvest would be necessary to significantly increase intercanopy herbaceous growth.

Recreation Management

Recreational off-road vehicle (ORV) use in the Santa Barbara watershed occurs primarily on public land, and disproportionately affects water quality compared with roads and hiking trails because ORV users often create user-developed trails running perpendicular to slopes, which channel water and sediment downhill. Most of this use is on Carson National Forest land at middle elevations (*i.e.*, generally not within the Pecos Wilderness). The Carson National Forest is conducting an environmental assessment (EA) to weigh options for a travel management plan for the Camino Real Ranger District. The EA will lead to a decision designating a system of roads open for use by motorized vehicles. Existing routes (roads or trails) not designated as “open” to motorized use will be closed and motorized use will no longer be legal on those routes⁹. Closed routes may continue to receive use, and even once effectively closed they may continue to erode, and so this category of management measure includes structural enforcement of closures and reclamation of closed roads beyond the actions that may be described in the travel management EA. Also within the category of recreation management is trail maintenance and improvement within the upper Rio Santa Barbara watershed. Though minor compared with ORV use, these hiking trails are subject to frequent summer thunderstorms and may produce turbid runoff reaching the Rio Santa Barbara. In 2000 and 2001, the West Fork and Middle Fork trails were maintained and proper drainage was installed. The East Fork trail has not received that treatment yet, and is often dramatically muddier as a result.

Unpaved Roads BMPs

Runoff from unpaved roads, including private driveways, County maintained roads, and unmaintained roads, is thought to contribute about 50 percent of the excessive TSS loading to the Rio Santa Barbara. Ninety percent of that loading, or forty-five percent of the overall target load reduction, may be prevented with implementation of best management practices to improve drainage from these roads, along with selective road

⁸ A review of the state of knowledge regarding fire ecology in piñon/juniper woodland is presented by Baker and Shinneman (*Forest Ecology and Management* 189 (2004) 1–21).

⁹ Relevant documents are available on line at www.fs.fed.us/r3/carson/recreation/travel_mgmt/index.shtml.

closure and reclamation¹⁰. The greatest road density is in the Peñasco area. Many of these roads and driveways are near the Rio Santa Barbara and Rio Chiquito, and are the highest priority for drainage improvements.

Riparian Grazing Management

Much of the private land within the Rio Santa Barbara and Rio Chiquito valleys is used as irrigated pasture. Often, a crop of hay will be produced either before or after livestock are let onto the pasture. Most is permanent pasture, seldom requiring tilling. Most private parcels are fenced. Where the river marks a property boundary, one or both adjacent property owners will typically maintain a fence that results in incidental protection of the river, even if only a narrow buffer is thus protected. Where a parcel crosses the river, livestock will generally have access to the river. The result is fenceline contrasts with dramatically different channel morphology from one parcel to another. Typically, where livestock have access to the stream, the channel is wider, shallower, and less protected by woody or other vegetation. Where fences are present, the channel is often much narrower (indicating lower bank erosion rates) and shaded by woody vegetation. This observation led to the conclusion that fencing of riparian areas to either exclude cattle or manage grazing on a controlled basis can reduce the excessive sediment loading by about fifteen percent. Fencing generally needs to be supplemented with gates (allowing livestock to be rotated through pastures), water crossings (where fences cross streams), water gaps (providing access of cattle to the stream for water), and off-channel water sources.

Bank Stabilization BMPs

Portions of the Rio Santa Barbara and Rio Chiquito within their lower valleys (generally on private property) were channelized beginning in the 1970's in an effort to prevent flooding. Straightening the channel led to an increase in channel slope, entrenchment, and erosiveness of flood flows, which together have created new cut banks, some of which in recent years have been treated with wire gabion baskets. Some of the older gabion baskets are beginning to fail. These areas present opportunities to utilize alternative bank stabilization techniques that preserve natural channel function (including maintaining floodplain capacity where possible), such as construction of cross-vanes, j-hooks, and other structures¹¹.

Mine BMPs

A small gravel pit near the Rio Chiquito lacks significant BMPs to prevent runoff from the mine and associated disturbed areas from reaching the Rio Chiquito. Ordinary stormwater detention practices could protect the Rio Chiquito (and the Rio Santa Barbara downstream) from a small amount of excessive loading of suspended sediment.

¹⁰ Appropriate BMPs are described in greater detail in *A Good Road Lies Easy on the Land... Water Harvesting from Low-Standard Rural Roads (2006)*, by Bill Zeedyk. This manual is available on line at quiviracoalition.org/images/pdfs/1597-A_Good_Road_Lies_Easy_on_the_Land.pdf.

¹¹ Fluvial geomorphologist Dave Rosgen has provided some guidance for cross-vanes and j-hooks at www.wildlandhydrology.com/assets/cross-vane.pdf. Another relevant handbook called *An Introduction to Induced Meandering: A Method for Restoring Stability to Incised Stream Channels* is available on line at quiviracoalition.org/images/pdfs/1905-Induced_Meandering_Field_Guide.pdf.

Arroyo Treatments

Arroyos leading to the Rio Santa Barbara typically flow through public and private lands in the piñon/juniper woodland on steeper terrain before reaching the valley. The arroyos are generally small, and may have tributary gullies which supply them with turbid runoff from adjacent uplands. The gullies themselves add to the sediment load, and arroyo channels often have unstable banks as a result of carrying so much sediment (which tends to push the channel to one side of the arroyo or the other). Sediment loading from piñon/juniper forest in this area can thus be divided into two categories – that from the uplands and best dealt with using forest restoration (described above), and that from within the channels of arroyos and gullies, which may be addressed more actively with structures of local materials such as post vanes, one-rock dams, baffles, and rock bowls¹².

Other

The meeting participants that contributed much of the above information on pollutant sources and management measures reached a point where consensus could not be attained either because of insufficient detailed information about sources, or differences in opinion regarding appropriate practices. In order to reach a conclusion that would permit progress towards implementation, the participants agreed to leave a portion of the excessive loading unaddressed by proposed management measures.

Table 3: Load reductions expected for specific management measures

Best Management Practices	Percent	Load (lb TSS / day)	Notes
Ponderosa pine forest restoration	1	15.03	Not much happening, relatively expensive, but preventative of major water quality degradation
USFS Grazing BMPs	4	60.12	
Piñon/Juniper forest restoration (thinning, firewood harvest)	5	75.15	
Recreation management (including ORVs)	8	120.24	Forest Service land and only a little private land. ORV access is important for firewood harvest and should be protected. The primary target for management is recreation. East Fork Santa Barbara trail is a small portion of this item.
Unpaved roads BMPs	45	676.35	
Riparian grazing management	15	225.45	
Bank stabilization BMPs	5	75.15	
Mine BMPs e.g. ponding areas	2	30.06	

¹² In addition to the *Induced Meandering* field guide, another useful handbook with more focus on smaller channels such as gullies is *An Introduction to Erosion Control*, available on line at quiviracoalition.org/images/pdfs/1902-Erosion_Control_Field_Guide.pdf.

Best Management Practices	Percent	Load (lb TSS / day)	Notes
Arroyo treatments e.g. one-rock dams, stock tanks	5	75.15	
other	10	150.3	
Totals	100%	1503	

Education and Information

Consistent with the schedule for implementation outlined below, the education and information program to support achieving and maintaining water quality standards has been placed into three main phases. The first and second phases are the implementation phases in which water quality standards will be achieved. The third phase is a maintenance phase, in which the goal is maintenance of water quality to meet standards.

Phase I: Engaging Early Implementers

The first implementation phase will rely on recruitment of early implementers, which may include stakeholders who assisted with development of this plan and other progressive landowners and agency personnel who already agree with the principles of the plan and may be familiar with many of the management measures to be implemented. Early implementers would be engaged by enlisting them to host or attend specialist workshops on unpaved roads BMPs, riparian grazing management, and erosion prevention.

The initial target audience for roads workshops would be equipment operators and managers for the Taos County Public Works Department. Landowners who are individually responsible for private roads and who have an interest in maintaining or improving their roads in a cost effective manner are also likely to attend these workshops. Initial demonstration work done on County roads during the workshops, if successful, will attract the attention of road users and boost attendance of later workshops by individual landowners.

While riparian grazing management may be primarily a matter of controlling livestock access to the stream, workshops may be useful. Workshops may be used to contrast conditions on nearby properties with and without riparian fencing, to highlight the benefits of increased forage production and reduced bank erosion that accompany managed grazing of riparian areas, to share technical information related to fence stream crossings and water sources for livestock, and to encourage early implementers. The primary target audience for this type of workshop is the individual owners of irrigated pasture within the Rio Santa Barbara and Rio Chiquito valleys.

Erosion prevention workshops proposed under this education program are of two main types. The first focuses on streambank stabilization methods and natural fluvial functioning that can assist landowners with preventing excessive erosion and recognizing

characteristics of streams, such as the periodic tendency to flood, that are better adapted to than fought. In some circumstances, banks may be strategically protected with structures or planted, to accelerate natural channel evolution processes towards a more stable form, and workshops may be used to help participants recognize and promote those processes. The second type of erosion prevention workshop, which may be conducted on private or public land, may be used to teach techniques of upland erosion prevention. None of these workshop subjects are mutually exclusive, but others have found each of these subjects to be appropriate for a two to three day workshop.

An additional category of outreach activities is related to public lands management. Generally, public lands managers are disposed towards management measures outlined in this plan, and possess appropriate skills and knowledge of the affected ecosystems and interrelated resources. Public lands are managed through public processes, however, and in this area particularly, public lands managers strive to serve the needs of watershed residents and sometimes face strong criticism for decisions without strong local support. Concerns such as smoke from prescribed fire, the viability of grazing as a business, and access to firewood all factor into public lands decisions. For these reasons, some extra effort may be required to engage the public in developing alternatives to implement ponderosa pine forest restoration, grazing BMPs on National Forest lands, piñon/juniper forest restoration, recreation management, and arroyo treatments on public lands. This effort may include retaining the services of a facilitator to conduct meetings and analysis in support of the NEPA process.

Phase II: Encouraging Widespread Implementation

In order for the plan to be fully implemented, at least one more round of more conservative implementers will need to be recruited in the second phase of implementation. Two conditions should be present in order to increase participation of this group. The first is that the results achieved by the early implementers should be at least partially successful, and the second is the presence of a local coordinator who can gain the rapport of, and share successes with, the more conservative implementers.

In the best-case scenario, the first few workshops outlined above will generate interest among another round of more skeptical landowners, who will attend additional workshops. There is no significant portion of public land in the Rio Santa Barbara where riparian streambank stabilization or grazing management projects or workshops can produce a lasting demonstration visible to the public. As such, participation in workshops is the main way for landowners to actually see the results of several proposed management measures, and hosting workshops will likely be a key incentive for some landowners to support implementation of management measures.

Another aspect to promoting more widespread implementation is to monitor parameters appropriate to measuring success towards water quality standards attainment, but also towards other objectives that landowners may have, such as reducing bank erosion, increasing forage for livestock, and experiencing drier conditions on roads during snowmelt or periods of frequent rains. A proposed monitoring program is described below. During later workshops, participants should revisit past work, be presented with

summaries of monitoring data indicating whether goals are being met, and progress should be reported in local newsletters to make this information more widely known.

A key aspect to encouraging widespread implementation is coordination. No organization or individual has been identified who possesses the necessary skill set, available time, and motivation to serve in this capacity. While some initial activities related to encouraging early implementation may be coordinated by an outside nonprofit or for-profit organization, a long term commitment will be required to maintain the continuity of the relatively complex implementation and education program outlined in this watershed plan. Success in the earlier phase may attract one or more individuals or organizations to serve in this capacity. While such a coordinator need not be a watershed resident, residence in the watershed would be a valuable attribute along with technical and business skills. This coordinator could also take the role of facilitator for some NEPA planning for work on public lands.

Phase III: Developing Incentives to Maintain Water Quality

As water quality improves in the impaired reach, protection of that improvement will be a challenge. This plan does not attempt to outline all of the relevant factors for this watershed, except to highlight a few possible opportunities that can reduce or overcome ongoing costs of maintaining a restored condition.

The notion that landscape level problems such as turbidity in the Rio Santa Barbara can be addressed with a one-time round of BMP installation ignores the reasons for present conditions. Some combination of ongoing subsidy or economic shifts conducive to water quality maintenance, and new enforcement measures would be required to maintain water quality standards. Further, although no significant threats to water quality exist in the upper Rio Santa Barbara watershed¹³, protection of water quality there warrants some attention.

The education efforts in Phase I and II will highlight incentives to maintain water quality where they occur. Only time will tell whether these incentives are sufficient to justify the economic costs of voluntarily preserving water quality, and even if they are economically sufficient their acceptance depends on social factors well beyond the scope of this plan.

Because of the abundant high quality cold trout waters on public lands in the area, where water quality standards are met (such as renowned trout streams within the upper Rio Santa Barbara watershed, and downstream on the Rio Embudo), restoration of the fishery within the lower Rio Santa Barbara does not present a significant economic incentive for

¹³ The upper Rio Santa Barbara watershed lies primarily within ecosystems which are naturally affected by stand-replacing fire at very infrequent intervals (perhaps once every two or three hundred years). While a major fire in the upper watershed would undoubtedly be detrimental to the trout fishery, such an affect may not be classified as an impairment relative to the state's water quality criterion for sediment, which reads, "Surface waters of the state shall be free of water contaminants including fine sediment particles (less than two millimeters in diameter), precipitates or organic or inorganic solids *from other than natural causes* that have settled to form layers on or fill the interstices of the natural or dominant substrate in quantities that damage or impair the normal growth, function or reproduction of aquatic life or significantly alter the physical or chemical properties of the bottom" [emphasis added].

landowners to implement components of this plan. Restoration of the fishery and improving other aspects of ecologic health may still present ethical or aesthetic incentives, however. Preliminarily, more significant economic incentives to maintain water quality are as follows:

Ponderosa Pine Forest Restoration

Provided that sufficient fuel is maintained to carry periodic fire, ponderosa pine forest restoration may produce an increase in available forage for livestock. In areas with homes or other infrastructure, insurance actuaries may eventually factor the ecologic state of nearby ponderosa pine forest into calculation of property insurance premiums. Also, once restored, the costs of utilizing prescribed natural fire to maintain ponderosa pine forest in a natural state are much lower than conducting prescribed burns or actively thinning trees to permit the use of fire without causing crown fires.

USFS Grazing BMPs

The management measures described above generally have some promise for producing better weight gains in livestock grazed on USFS lands, partially compensating for the costs of those practices. Increased demand for grass-fed or local beef, or conversely decreased subsidization of corn- or soy-fed beef production systems, may improve the economics of public lands livestock production and thus may make some new costs of production more affordable.

Piñon/Juniper Forest Restoration

A primary means of implementing this management measure is through firewood harvest. Approximately 80% of households in the area depend on firewood for heat, and many area residents are engaged in firewood harvest for their own homes or as a business activity. Existing activity may be focused within this specific watershed to achieve objectives related to water quality.

Recreation Management (Including ORVs)

ORV use may decrease within this watershed in the near term as a result of management changes being contemplated by the Carson National Forest. Thus, an enforcement mechanism may prevent new ORV routes from developing at the rate seen in recent decades. Area residents are likely to need to access areas for firewood harvest, and low-impact ORV use (e.g., selecting routes to minimize impacts, and avoiding use in wet conditions) can be prescribed within firewood harvest permits and stewardship contracts.

Unpaved Roads BMPs

Properly drained roads concentrate runoff less than roads which capture or retain flow on their surfaces. Properly drained roads also require less maintenance to correct erosion problems, they generally produce less wear and tear on vehicles, and they may support faster average speeds. These benefits may largely offset the costs of training, labor, and equipment associated with installing and maintaining proper drainage.

Riparian Grazing Management

Limiting grazing within riparian areas (or pastures in general) to short periods of intense grazing may result in greater total forage production, faster weight gain by livestock, and protection of woody riparian plants sufficient to increase bank stability. Many private parcels within the Rio Santa Barbara and Rio Chiquito valleys are too small for economic livestock production or subdivision into pastures (including riparian pastures). However, some property owners may find that leasing these pastures is easier than using them themselves, and livestock producers with several adjacent or nearby leases may be able to operate a group of properties as managed pastures, with less impact overall to riparian areas. In addition to the economics of raising livestock, hay production, and leasing pastures, increased streambank stability (i.e., reduced erosion) provides an incentive for landowners to pursue improved management options. Increased streambank stability in the vicinity of acequia diversions may also reduce costs of maintaining the diversions.

Bank Stabilization BMPs

In addition to the benefits of reducing or changing grazing pressure described above, more active management measures also generally reduce erosion and may protect irrigation infrastructure.

Mine BMPs

The proposed management measures may already be required by existing regulations. Thus, an existing enforcement mechanism may serve to partially or wholly cause these measures to be implemented.

Arroyo Treatments

On private land, the treatments identified by this plan may help landowners preserve or increase the value of their property by reducing and stabilizing gullies and arroyo cut banks.

Monitoring Progress

The primary purposes of monitoring outlined in this plan are to measure progress of implementation against milestones identified below, to model pollutant load reductions that are expected to accompany implementation, to detect changes in water quality over time, and to determine whether water quality standards are being met in the Rio Santa Barbara.

Implementation Monitoring

Progress towards implementing the identified management measures, in the units specified in Table 4 (below), will be tracked and reported in revisions of this plan and in reports required by organizations funding implementation of this plan. Each individual structure and treated area will be photographed and designated with a tracking number and GPS position to enable follow-up monitoring, to determine whether the measure has been effective at its intended site-specific purpose (e.g., prevent bank erosion) and whether any maintenance or adjustments are necessary. Implementation monitoring will provide photographic data and evidence that structures have accomplished their site-

specific goals, which will be essential information in recruiting more conservative implementers and in qualifying for some sources of funding.

Pollutant Load Reduction Modeling

Pollutant load reductions will be estimated based on implementation progress relative to total need outlined in Table 4 (below), coupled with the load estimates provided in Table 3 (above). For example, if 10 drainage features are installed on unpaved roads, then an estimated daily load reduction (under wet weather conditions) of 13.5 pounds per day of total suspended solids will be realized ($10/500 \times 676.35$ lb TSS/day).

Effectiveness Monitoring

Effectiveness monitoring will be conducted using an approach outlined by Grabow and others¹⁴. The specific approach will be the upstream/downstream, before/after approach, in which data are collected from two points above and below BMP implementation, both before and after BMP implementation. This approach is cost effective, feasible for non-statisticians, and has the promise of permitting scientifically valid conclusions regarding whether pollutant loading has changed between sampling points. Due to natural variations in water quality that are unrelated to BMP implementation, the method cannot be expected to detect real water quality changes of small magnitude, and so should not be relied upon entirely as an indicator of progress. The Surface Water Quality Bureau's Watershed Protection Section has an effectiveness monitoring program that can either assist with or conduct this monitoring, including development of more detailed study designs.

Assessment of Standards Attainment

Both the Pueblo of Picuris and the State of New Mexico implement monitoring programs under Section 106 of the Clean Water Act, a primary purpose of which is assessment of standards attainment. As such, either entity may continue to recognize impairment, or may recognize that standards are attained, based on available data. Such decisions are reviewed and approved by either the New Mexico Water Quality Control Commission or the Governor of the Pueblo, and by EPA, generally with public input.

The Surface Water Quality Bureau Monitoring and Assessment Section (MAS) is responsible for this program for the State of New Mexico. To provide data to be used for assessment, MAS conducts water quality surveys on a rotating watershed basis, surveying each major watershed approximately one year out of eight. MAS conducted a survey in 2009 that included the Rio Santa Barbara. Data collected during the 2009 survey may be assessed in time to affect the *State of New Mexico Clean Water Act §303(d)/§305(b) Integrated Report* for 2012 – 2014. SWQB is developing a new assessment protocol to allow assessment of data against the narrative turbidity criterion, which was adopted (replacing a numeric criterion) after the turbidity TMDL was developed. Future assessment of the Rio Santa Barbara depends on completion of this protocol.

¹⁴ Grabow, G.L., J. Spooner, L. A. Lombardo, and D. E. Line. 1992. *Detecting water quality changes before and after BMP implementation: use of a spreadsheet for statistical analysis*. NWQEP Notes 92: 1 – 9. This article is available on line at www.bae.ncsu.edu/programs/extension/wqg/issues/92.pdf.

If in the future this plan is essentially implemented, and either the State or the Pueblo finds that the turbidity standard is still not met, then NMED or the Pueblo may develop a new TMDL to reflect current conditions and provide a revised target load reduction.

Technical and Financial Assistance Needed

Table 4 lists the estimated costs for implementing the management measures, education, and monitoring identified above. Each management measure cost is based on an estimate of the cost of materials, equipment, and labor, with an additional ten percent added for design, consultation, meetings, and planning at a level of detail beyond the scope of this watershed plan. The “general coordination” item under education includes the costs incurred by a coordinator, but no costs incurred by landowners, agency staff, or contractors. It is anticipated that projects developed to implement this watershed plan will include design and planning phases to provide more detailed information such as the precise locations and placements of structures.

Table 4: Estimated implementation costs

Management Measure Category	Management Measure Subcategory	Units	Units Needed	Estimated Cost per Unit	Total Cost
Ponderosa pine forest restoration	Thinning	ac	1000	\$500.00	\$500,000.00
Ponderosa pine forest restoration	Prescribed burning	ac	5000	\$50.00	\$250,000.00
Ponderosa pine forest restoration	Prescribed natural fire	ac	8000	\$2.00	\$16,000.00
Subtotal					\$766,000.00
USFS grazing BMPs	Drift fencing	mi	5	\$11,000.00	\$55,000.00
USFS grazing BMPs	Herding	season	5	\$32,000.00	\$160,000.00
USFS grazing BMPs	Range monitoring	pasture	105	\$200.00	\$21,000.00
USFS grazing BMPs	Hiking stiles	each	3	\$1,000.00	\$3,000.00
USFS grazing BMPs	Corrals and holding pens	each	3	\$5,000.00	\$15,000.00
Subtotal					\$254,000.00
Piñon/juniper forest restoration	Firewood harvest	ac	500	\$50.00	\$25,000.00
Piñon/juniper forest restoration	Other thinning	ac	1000	\$500.00	\$500,000.00
Subtotal					\$525,000.00
Recreation management	Install drainage features on designated ORV routes	each	200	\$825.00	\$165,000.00

Management Measure Category	Management Measure Subcategory	Units	Units Needed	Estimated Cost per Unit	Total Cost
Recreation management	Close unauthorized ORV routes	each	30	\$1,100.00	\$33,000.00
Recreation management	Install drainage features to reclaim unauthorized ORV routes	each	50	\$825.00	\$41,250.00
Recreation management	Install drainage features on East Fork Trail	mi	6	\$3,000.00	\$18,000.00
Subtotal					\$257,250.00
Unpaved roads BMPs	Install drainage features on unpaved roads and driveways	each	500	\$1,650.00	\$825,000.00
Unpaved roads BMPs	Selective road closure	each	20	\$1,100.00	\$22,000.00
Unpaved roads BMPs	Reclamation of closed roads (installation of drainage features)	each	30	\$1,650.00	\$49,500.00
Subtotal					\$896,500.00
Riparian grazing management	Fencing (inc. gates and water crossings)	ft	10000	\$1.52	\$15,200.00
Riparian grazing management	Water gaps	each	7	\$2,000.00	\$14,000.00
Riparian grazing management	Off-channel water sources	each	15	\$550.00	\$8,250.00
Subtotal					\$37,450.00
Bank stabilization BMPs	Boulder vanes	each	10	\$2,640.00	\$26,400.00
Bank stabilization BMPs	Post vanes	each	20	\$1,760.00	\$35,200.00
Bank stabilization BMPs	Log vanes	each	10	\$1,320.00	\$13,200.00
Bank stabilization BMPs	Baffles	each	5	\$2,090.00	\$10,450.00
Bank stabilization BMPs	Boulder cross-vanes	each	10	\$4,950.00	\$49,500.00
Subtotal					\$134,750.00
Mine BMPs	Ponding areas	cy	10000	\$3.00	\$30,000.00
Mine BMPs	Disturbed area reclamation	ac	2	\$244.13	\$488.26
Subtotal					\$30,488.26
Arroyo treatments	Post vanes	each	20	\$1,320.00	\$26,400.00
Arroyo treatments	One-rock dams	each	100	\$220.00	\$22,000.00
Arroyo treatments	Baffles	each	20	\$1,650.00	\$33,000.00

Management Measure Category	Management Measure Subcategory	Units	Units Needed	Estimated Cost per Unit	Total Cost
Arroyo treatments	Rock bowls	each	20	\$550.00	\$11,000.00
Subtotal					\$92,400.00
Education	Roads workshop	each	5	\$7,500.00	\$37,500.00
Education	Gully treatment workshop	each	5	\$5,000.00	\$25,000.00
Education	Riparian restoration workshop	each	5	\$7,500.00	\$37,500.00
Education	Local watershed tours / conferences	each	4	\$5,000.00	\$20,000.00
Education	Literature printing and distribution	each	2	\$11,000.00	\$22,000.00
Education	General coordination	year	7	\$26,000.00	\$182,000.00
Subtotal					\$324,000.00
Monitoring	Implementation monitoring	year	10	\$2,000.00	\$20,000.00
Monitoring	Load reduction modeling	year	10	\$100.00	\$1,000.00
Monitoring	Effectiveness monitoring	year	5	\$17,000.00	\$85,000.00
Monitoring	Assessment of standards attainment	each	2	\$7,500.00	\$15,000.00
Subtotal					\$121,000.00
Grand Total					\$3,438,838.26

Funding which is already available to support implementation of this plan include United States Forest Service operational funds (which are well suited for NEPA planning and small on-the-ground projects), Taos Soil and Water Conservation District operational funds (supported by a small tax levee), and Taos County Public Works Department (which has available a budget for maintenance of County roads).

Other possible sources for funding implementation of this watershed plan are listed in the 2009 State of New Mexico Nonpoint Source Management Plan, Appendix D¹⁵. This document also lists several on-line tools for identifying funding opportunities.

One of the more likely initial sources of new funding will be the Clean Water Act Section 319 program. This program and the funding made available through it are primarily intended to directly or indirectly restore water bodies to meet water quality standards and support designated uses. This plan has been tailored to meet the requirements for this program, increasing eligibility for funding. Funding programs commonly require specific planning elements to have been completed prior to application for funding, or express preference for specific planning to have been completed, and thus most other sources of

¹⁵ This document is available on line at <ftp://ftp.nmenv.state.nm.us/www/swqb/WPS/NPSPlan/WQCC-Approved2009NPSPlan.pdf>.

funds will not be available as soon. Section 319 funds are available on a competitive basis through the New Mexico Environment Department, which conducts a request for proposals on an approximately annual basis. An RFP is planned for early 2010.

Provided that the New Mexico Legislature authorizes the program in 2010 or beyond, the River Ecosystem Restoration Initiative is another program with goals consistent with components of this watershed plan. Another mechanism of funding available through the New Mexico State Legislature is the Water Trust Board process, in which a board with representation by several cabinet-level agencies recommends, on an annual basis, funding of water-related projects identified through an application process coordinated by the New Mexico Finance Authority. Several years ago, the board created a category of project related to watershed management, and has received only a small number of applications each year. The board has received applications for projects which would implement TMDLs, and at least one such project was recommended and funded. This source of funding is only available to local or Tribal governments (including SWCDs).

A source of funding appropriate for implementing agricultural best management practices is the Environmental Quality Incentives Program (EQIP) administered by the USDA Natural Resources Conservation Service. This program is well-suited to individual private property owners who use their land for agriculture, although under some circumstances the program may be used on public land. Because of the reliance of EQIP on individual applications for relatively small projects, projects appropriate for accomplishing the goals of this plan are most likely to result from the aid of a coordinator.

The Habitat Stamp Program administered by the New Mexico Department of Game and Fish may be well-suited to the management measure of establishing off-channel water sources for livestock on National Forest land, if elements are included to provide water for wildlife and prevent accidental drowning by wildlife. NMDGF has supported this type of activity in the past both to benefit upland wildlife populations and to protect riparian areas for riparian-dependent wildlife and fisheries.

Schedule for Implementation

A schedule for implementation is presented in

Table 5 (Phase 1) and **Table 6** (Phase 2). These tables include all of the needed items identified in **Table 4** (above), except for a portion of the prescribed natural fire, which is primarily a management measure appropriate for maintaining a restored state (*i.e.*, Phase 3).

Table 5: Schedule for implementation (Phase 1)

Management Measure Subcategory	Units	Units Needed	Phase 1 - Early Implementation				
			2011 (year 1)	2012 (year 2)	2013 (year 3)	2014 (year 4)	2015 (year 5)
Ponderosa pine thinning	ac	1000			50	100	150
Ponderosa pine prescribed burning	ac	5000				100	200
Ponderosa pine prescribed natural fire	ac	8000					200
USFS drift fencing	mi	5					1
USFS herding	season	5					
USFS hiking stiles	each	3	3				
USFS Corrals and holding pens	each	3		3			
USFS Range monitoring	pasture	105			7	14	14
P/J firewood harvest	ac	500	50	50	50	50	50
P/J other thinning	ac	1000			100	200	300
Install drainage features on designated ORV routes	each	200	10	20	40	80	50
Close unauthorized ORV routes	each	30	10	20			
Install drainage features to reclaim unauthorized ORV routes	each	50	10	20	20		
Install drainage features on East Fork Trail	mi	6				3	3
Install drainage features on unpaved roads and driveways	each	500	20	40	50	50	100
Selective road closure	each	20		1	2	3	4
Reclamation of closed roads (installation of drainage features)	each	30		2	3	4	5

Management Measure Subcategory	Units	Units Needed	Phase 1 - Early Implementation				
			2011 (year 1)	2012 (year 2)	2013 (year 3)	2014 (year 4)	2015 (year 5)
Private lands fencing (inc. gates and water crossings)	ft	10000	100	400	1500	1500	2000
Water gaps	each	7		1	1	1	2
Off-channel water sources	each	15	1	1	2	2	3
Boulder vanes	each	10		1	2	2	2
Post vanes	each	20		1	2	3	4
Log vanes	each	10		1	1	2	2
Baffles	each	5		1	1	1	1
Boulder cross-vanes	each	10		1	2	2	2
Ponding areas	cy	10000					10000
Disturbed area reclamation	ac	2					2
Post vanes	each	20		2	3	4	5
One-rock dams	each	100		8	15	14	12
Baffles	each	20		2	3	4	4
Rock bowls	each	20		1	2	3	5
Roads workshop	each	5	1		1		1
Gully treatment workshop	each	5		1		1	
Riparian restoration workshop	each	5	1		1		1
Local watershed tours / conferences	each	4				1	
Literature printing and distribution	each	2	1				1
General coordination	year	7				1	1
Implementation monitoring	year	10	1	1	1	1	1
Load reduction modeling	year	10	1	1	1	1	1
Effectiveness monitoring	year	5	1		1		1
Assessment of standards attainment	each	2		1			

Table 6: Schedule for implementation (Phase 2)

Management Measure Subcategory	Units	Units Needed	Phase 2 - Widespread Implementation				
			2016 (year 6)	2017 (year 7)	2018 (year 8)	2019 (year 9)	2020 (year 10)
Ponderosa pine thinning	ac	1000	200	200	200	100	
Ponderosa pine prescribed burning	ac	5000	400	800	1500	1500	500
Ponderosa pine prescribed natural fire	ac	8000					1000
USFS pasture fencing	mi	5	2	2			
USFS herding	season	5	1	1	1	1	1
USFS Range monitoring	pasture	105	14	14	14	14	14
P/J firewood harvest	ac	500	50	50	50	50	50
P/J other thinning	ac	1000	300	100			
Install drainage features on designated ORV routes	each	200					
Close unauthorized ORV routes	each	30					
Install drainage features to reclaim unauthorized ORV routes	each	50					
Install drainage features on East Fork Trail	mi	6					
Install drainage features on unpaved roads and driveways	each	500	50	50	50	50	40
Selective road closure	each	20	2	2	2	2	2
Reclamation of closed roads (installation of drainage features)	each	30	4	4	3	3	2
Private lands fencing (inc. gates and water crossings)	ft	10000	1500	1000	1000	500	500
Water gaps	each	7	1	1			

Management Measure Subcategory	Units	Units Needed	Phase 2 - Widespread Implementation				
			2016 (year 6)	2017 (year 7)	2018 (year 8)	2019 (year 9)	2020 (year 10)
Off-channel water sources	each	15	2	2	2		
Boulder vanes	each	10	2	1			
Post vanes	each	20	4	4	2		
Log vanes	each	10	2	1	1		
Baffles	each	5	1				
Boulder cross-vanes	each	10	2	1			
Ponding areas	cy	10000					
Disturbed area reclamation	ac	2					
Post vanes	each	20	3	3			
One-rock dams	each	100	11	10	10	10	10
Baffles	each	20	2	2	2	1	
Rock bowls	each	20	5	2	2		
Roads workshop	each	5		1		1	
Gully treatment workshop	each	5	1		1		1
Riparian restoration workshop	each	5		1		1	
Local watershed tours / conferences	each	4	1		1		1
Literature printing and distribution	each	2					
General coordination	year	7	1	1	1	1	1
Implementation monitoring	year	10	1	1	1	1	1
Load reduction modeling	year	10	1	1	1	1	1
Effectiveness monitoring	year	5			1		1
Assessment of standards attainment	each	2					1

Milestones

This section outlines the major events that can be used to determine how implementation of this plan compares with the above schedule. One milestone has been identified for each year of the plan’s first and second phases.

Table 7: Milestones

Year	Milestone	Significance
2011	Initial implementation	Initial implementation indicates that the plan is being implemented, and can add support for the plan by demonstrating that it has lead to action.
2012	Assessment of standards attainment	Assessment of standards attainment is dependant on development of a new assessment protocol for turbidity, and may confirm the need for this plan early in its implementation.
2013	Commencement of active forest restoration	Active forest restoration, which includes thinning and prescribed burning, may only commence on USFS land with significant support of the Forest administration and technical staff, following establishment of purpose and need, NEPA analysis with public input, sufficient funding appropriate for this activity, and adherence to complicated procurement procedures. On private lands, funding sources such as the Collaborative Forestry Restoration Program are accessible on a competitive basis to those willing to pursue a separate detailed planning process. These hurdles make commencement of active forest restoration a significant milestone for this watershed.
2014	Coordinated restoration begins	Before this milestone, implementation is likely to occur at some level, but with little coordination and possibly with leadership provided by organizations located outside of the watershed, or organizations lacking permanent responsibility within the watershed. Local or regional coordination will increase the rate of implementation to a level that is more likely to achieve the goals of this watershed plan.
2015	Peak implementation	Implementation accomplishments for each year can be compared with the goals for each year identified in Table 5 , and together provide an indication of whether implementation is proceeding as planned. 2015 is the approximate year in which most activities will be at their peak of implementation.
2016	Significant effectiveness and implementation monitoring reports presented at local watershed conference	2016 is the first year when statistically significant effectiveness monitoring results may exist for presentation at a local watershed conference. Implementation monitoring will provide photographic data and evidence that

Year	Milestone	Significance
		structures have accomplished their site-specific goals. If successful, this information will be essential in recruiting more implementers and in qualifying for some sources of funding. If not successful, this information may lead to revision of the watershed plan.
2017	Effective prescribed natural fire policy in place	Existence of a policy to allow prescribed natural fire in ponderosa pine forest ecosystems will be necessary for this management tool to be used at a level appropriate for maintaining ponderosa pine ecosystems. Development of such a policy depends on public support, policy support by the NMED Air Quality Bureau, and the will of USFS management and technical staff to develop this policy amid competing priorities.
2018	Active bank stabilization work is completed	Completion of a major category of management practice will signify that implementation of the plan is nearing completion, and also signals a period of greater focus on interpreting monitoring results and possible plan revisions.
2019	Thinning is completed	Completion of a major forest thinning initiative on Forest Service land will signify that the Carson National Forest has fulfilled the main expectations for a project developed with significant public input.
2020	Assessment of standards attainment	The Surface Water Quality Bureau, Monitoring and Assessment Section, will conduct a water quality survey to enable assessment of standards attainment within this watershed in approximately 2018. The data collected may be the first such data available to enable assessment, which can be published in 2020. If the plan has been implemented and the Rio Santa Barbara is found to meet its water quality standards for turbidity, then this plan will have accomplished its goals. More information is provided in the following section.

Criteria for Measuring Success

If this plan has been implemented and the Rio Santa Barbara is found to meet its water quality standards for turbidity, then the plan will have accomplished its goals. Assessment of standards attainment is expected to take place in 2012 (before significant implementation) and 2020 (after significant implementation).

A milestone expected in 2016 (“significant effectiveness and implementation monitoring reports presented at local watershed conference”) will provide an interim measure of success. Effectiveness monitoring may also provide an indication whether progress has been made if, in 2020, the Rio Santa Barbara still does not meet its water quality criterion for turbidity.

If in 2020 this plan has been substantially implemented, the Rio Santa Barbara does not meet its water quality criterion for turbidity, and effectiveness monitoring data show less improvement in water quality than expected given the level of implementation, or if there is no statistically significant improvement in water quality, then the plan will be revised using guidance, information about management measures, and program approaches which have not yet been developed.

Several other developments may occur which would warrant revision of this plan.

If the waters within the Rio Santa Barbara watershed are found to meet their water quality standards in 2020 (or sooner), this plan will be revised to focus on protecting water quality.

The Pueblo of Picuris may develop a TMDL for turbidity or other parameters during the period outlined in Table 7. In the event that a TMDL is set which is lower (*i.e.*, more protective of water quality) than the current State of New Mexico TSS TMDL, or in the event that a TMDL is adopted by either the State of New Mexico or the Pueblo of Picuris for a parameter other than TSS for any water within the Rio Santa Barbara watershed, this plan will be revised.

However, until such time as the plan is revised, this plan will still be considered valid for the subject reach of the Rio Santa Barbara (NM assessment unit NM-2120.A_419). This statement applies as long as a recognized turbidity impairment and TSS TMDL are in place. Also, if a lower TSS TMDL is established, implementation of the management measures identified in this document should proceed until such time as the watershed plan can be revised.