Prepared pursuant to the Clean Water Action Plan and Unified Assessment of New Mexico watersheds

San Juan Basin

Watershed Management Plan

January 2005

Developed by the San Juan Watershed Group

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1. INTRODUCTION

The San Juan Basin Watershed Management Plan addresses protection and restoration of water quality in the perennial streams of the San Juan Basin within New Mexico, exclusive of the watershed areas upstream of Navajo Dam and downstream of the boundary of the Navajo Nation. This area includes portions of five cataloging units ("watersheds") delineated by the United States Geological Survey (Figure 1). These are the Upper San Juan (HUC 14080101), Blanco Canyon (HUC 14080103, better known by the larger Largo Canyon), Animas (HUC 14080104), Middle San Juan (hydrologic unit code 14080105), and Chaco (HUC 14080106) watersheds. The San Juan River flows through the Middle and Upper San Juan watersheds (with the Upper San Juan watershed upstream from the confluence of the Animas and San Juan Rivers), the Animas River flows through the Animas watershed, the La Plata River flows within the Middle San Juan watershed, and an undetermined number of short perennial segments flow within arroyos tributary to the San Juan River in the Middle and Upper San Juan watersheds. The large Largo Canyon and Chaco River watersheds contain no significant perennial stream reaches, although each delivers large amounts of sediment and water to the San Juan River following precipitation events. These large watersheds and numerous smaller subwatersheds with ephemeral flow are included in the project area because of the effects that they may have on water quality in perennial streams.

Tables 1 through 5 summarize the land management jurisdictions within each watershed.

Table 1: Upper San Juan Watershed (in New Mexico)

Surface Management	Acres
BLM	385,631
USBR	28,965
USFS	120,612
USFWS	316
Navajo Nation	150,351
Jicarilla Apache	225,920
Private	187,536
State	49,148
State Game and Fish	4,595
Total	1,153,074

Table 2: Largo Watershed

Surface Management	Acres
BLM	434,679
USBR	502
USFS	43,515
Jicarilla Apache	430,086
Private	126,753
State	50,675
Total	1,086,210

Table 3: Animas Watershed (in New Mexico)

Surface Management	Acres
BLM	76,415
NPS	33
Private	59,276
State	12,663
Total	148,387

Table 4: Middle San Juan Watershed (in New Mexico)

Surface Management	Acres
BLM	92,815
USBR	615
Navajo Nation	509,294
Ute Mountain Ute	103,578
Private	80,443
State	14,412
Total	801,158

Table 5: Chaco Watershed

Surface Management	Acres
BLM	318,409
Jicarilla Apache	1,203
Navajo Nation	2,384,044
NPS	34,198
Private	76,284
State	105,972
Total	2,920,111

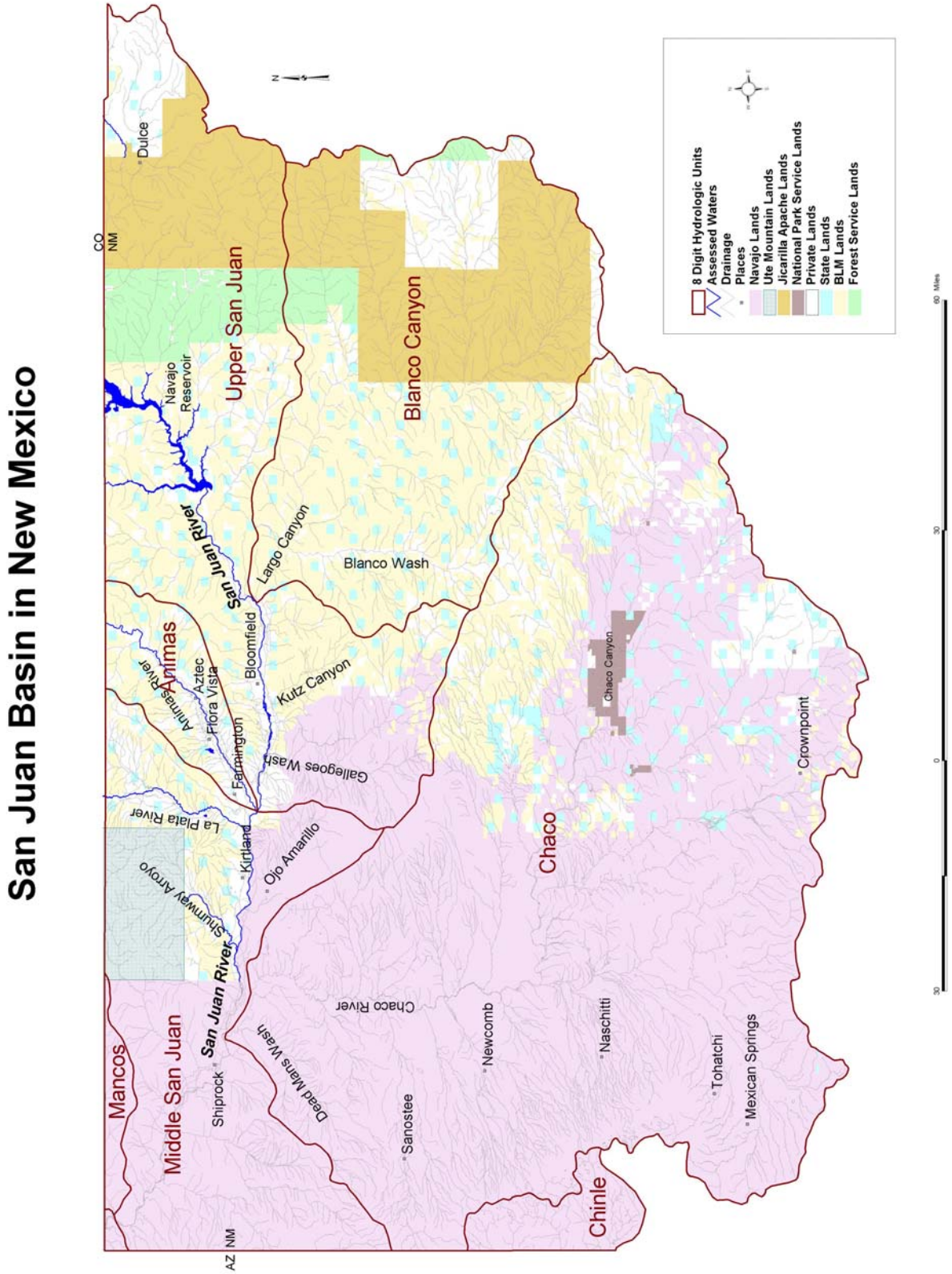

Figure 1: San Juan River Basin in New Mexico

The acreages in Table 1 - Table 5 for Native American lands are reservation and tribal trust lands, but do not include fee, allotted, or public land order lands. Most of these other lands are shown as BLM land in Figure 1. The jurisdictions of these other lands with respect to water quality may lie with EPA, rather than the State of New Mexico.

The San Juan Watershed Group began meeting at the Farmington Civic Center in August of 2001 to assess and discuss water quality issues within this area. The meetings were facilitated by Gary Broetzman of the Meridian Institute, Dillon, Colorado, with funding from the Clean Water Act Section 319 program administered by the United States Environmental Protection Agency (USEPA) and New Mexico Environment Department (NMED). The valuable contributions of time and effort by many members of the community, representing federal, state, and local agencies, industry, citizens' groups, and the community at large are summarized in this document.

Mission and Goals

During their second and third meetings, the San Juan Watershed Group drafted as an initial mission "to protect current and future uses of surface waters in the San Juan watershed through identification of water quality concerns and by seeking solutions for problems defined". Four goal statements were also drafted to support this mission:

- Review water quality standards, identify problem parameters, and assist the New Mexico Environment Department, as needed, in developing total maximum daily loads.
- Encourage a balanced approach for bringing problem parameters into compliance; look for implementing best management practices to keep those problems from worsening.
- Develop a comprehensive monitoring strategy.
- Focus on surface water concerns and connected shallow aquifers.

A Living Document

The San Juan Basin Watershed Management Plan is one of several planning documents developed for the Basin over the years, by different agencies or groups, and with different emphases, that address aspects of water quality. This Plan is distinguished from the others by its primary emphasis on water quality, its broad base of local contributors, and the intent that the document shall be useful to all organizations and individuals that set policies, conduct projects, or contribute to decisions affecting water quality in the San Juan Basin. This Plan documents the consensus within the San Juan Watershed Group regarding the current quality of the Basin's streams and shallow connected aquifers, and the most promising approaches to protect or restore that quality. The Group's focus is on water quality issues of importance to the communities and stakeholders of the San Juan basin, and these issues may differ from those identified or addressed by the New Mexico Environment Department.

This Plan is organized into six sections. These are a section on the development of the San Juan Watershed Group, a section on past and present water quality monitoring activities within the Basin (with consideration of additional monitoring that should be conducted), a section on identified water quality problems within the Basin, another section that describes actions or projects identified to address these water quality problems, a section on funding needs and programs that may be useful in bringing the Watershed Management Plan to fruition, and a schedule for implementation.

Significant new developments may occur, and new information will likely become available, that will make this document obsolete. The reader may also note inaccuracies, omissions, or other errors within the document. The San Juan Watershed Group plans to review and revise this document every two years, with the next revision to be completed by January 2007. Until that time, comments may be directed to Abe Franklin (505-827-2793 or abraham_franklin@nmenv.state.nm.us), or to Gary Broetzman (970-947-9900 or gbroetzm@rof.net), for consideration by the group during the next review.

2. THE SAN JUAN WATERSHED GROUP

The San Juan Watershed Group came together for their first meeting on August 30 2001. Gary Broetzman of the Meridian Institute (Dillon, CO) made the initial contacts to invite key individuals to the meeting, advertised the meeting in local media, and facilitated that and successive meetings. The Meridian Institute conducted this work under contract to the New Mexico Environment Department, with funding from the Clean Water Act Section 319 program. The workplan for that contract summarizes the work to be done (for four areas in New Mexico) as follows:

> The objective of each of these watershed initiatives will be to establish a collaborative watershed process involving all key interests and affected parties. That process will help achieve local understanding of the State's water quality management system (including TMDLs and load allocations), identification of contributing sources of those pollutants to be controlled under the TMDLs, development of a locally acceptable remediation plan for efficiently achieving those load reductions, and remedial activities at priority sites. In addition to a focus on the above, it is critically important that the watershed group play an active role in developing the process for achieving the above tasks.

Meeting records indicate that 121 people have signed in at thirty-one meetings held through October 2004. A full roster of individuals attending meetings is found in Appendix A. Fifty-three organizations are represented, in addition to several citizen participants who do not affiliate themselves with an organization. Among the organizations are local, state, federal, and tribal governments, private businesses, non-profit organizations, and at least one educational institution. The private businesses include energy production companies and related extractive industry, consulting firms, treatment plant operators, and at least one outfitting service for sport fishermen. The non-profit organizations include environmental groups, water-users associations, and an irrigation ditch association.

Currently active participants include Gary Broetzman (the meeting facilitator), Chester Anderson (BUGS Consulting), Rob Ashman (of the Public Service Company of New Mexico, which operates the San Juan Generating Station), Dave Barr (citizen), Aaron Chavez (San Juan Water Commission), Scott Clow (Ute Mountain Ute Tribe), Jimmie Fisher (Lower Animas Ditch Association), Abe Franklin (New Mexico Environment Department Surface Water Quality Bureau), Amy Haun (San Juan County Water Association), Steve Hayden (New Mexico Oil Conservation Division), Errol Jensen (U.S. Bureau of Reclamation), Allen Maez (Natural Resources Conservation Service), Wayne Mietty (River Reach Foundation), Paul Montoia (City of Farmington), Ken Stanley (citizen), Dave Tomko (New Mexico Environment Department Farmington Field Office), Chuck Wanner (San Juan Citizens Alliance), Zang Wood (citizen), and Carl Woolfolk (Arizona Public Service Company, which operates the Four Corners Power Plant).

Of the people whose attendance has declined, several have interests which are too specific to receive thorough and regular attention by the full group, or have interests which are not well addressed by New Mexico's or EPA's water quality programs. Others have changed positions, or have co-workers who have more recently begun participating. Still others continue to monitor the Group's activities and may contribute again when their interests return to the agenda.

Participation of unaffiliated citizens and nonprofit organizations, while still less than that of agency and industry personnel, increased in 2003-2004, despite the limitations of the Watershed Group forum. No representatives of county governments have attended any meetings, although a San Juan County representative does monitor meeting announcements, meeting summaries, and related email correspondence.

The above statistics notwithstanding, some active participants attended their first meeting relatively recently, and attendance does not necessarily equate to participation. Further, some activities of the watershed group are conducted (and products are developed) outside of group meetings, and so it is possible for participants to meaningfully participate without attending every meeting. The products and activities of the watershed group have increasingly drawn on the specializations of the participants.

Thirty-two meetings have been held since the first meeting (through December 2004). Table 6 briefly summarizes the meetings held to date[1].

Table 6: San Juan Watershed Group Meeting Topics

Meeting Date	Agenda Topics
8/30/2001	Presentation by SWQB staff and Gary Broetzman titled "Why are we here?" local responses, and relationships of this watershed initiative with other projects and activities.
10/18/01	Mission statement and goals (group discussion), description of the grant supporting this initiative (Gary Broetzman), basic listing of available water quality data (group discussion)
11/29/01	Completion of the basic listing of available data, formation of a data subcommittee to define data needs and develop a sampling plan for SWQB for 2002, presentation on designated uses and water quality standards (Lynette Stevens, SWQB), and planning method of topic selection for next several meetings (group discussion).
1/22/02	Data subcommittee report (Neal Schaeffer, SWQB), presentations by Bob Krakow (BIA/NIIP), John Whipple (ISC), and Ron Bliesner (Keller-Bliesner Engineering) on the SJBRIP, request for comments by Gary Broetzman on near-term straw workplan for the group developed by he, Abe Franklin and Paul Martin.
2/28/02	Presentation on TMDL program (Stephanie Stringer, SWQB), description of data subcommittee activities (Lynette Stevens), description of draft monitoring plan developed by data subcommittee (Neal Schaeffer).

[1] Meeting notes are available from the New Mexico Environment Department Surface Water Quality Bureau (P.O. Box 26110, Santa Fe, NM 87502, 505-827-0187) or on the Internet at http://www.nmenv.state.nm.us/swqb/wps/San_Juan/Meeting_Summaries.pdf

Meeting Date	Agenda Topics
4/18/02	Status of monitoring (Abe Franklin), presentation by Gary Broetzman (and group discussion) of a near-term workplan for the group, decision-making processes (group discussion), natural loading of sediments (Nicholas Bugosh).
5/30/02	Follow-up group discussion of natural loading of sediments, listing of priority watersheds or streams, listing of projects in progress which include water quality improvement as a component.
7/11/02	Regional Water Plan (Shaun Bishop, SJWC), SWQB approach for developing a protocol for assessing sedimentation for large rivers (Abe Franklin), possible early water quality improvement projects (group discussion), potential funding sources (Abe Franklin, SWQB and Lloyd Wilhelm, NRCS).
8/22/02	Updates from various participants, overview of the upper Animas River Stakeholder Group (Bill Simon, ARSG).
9/26/02	Sedimentation study status (Lynette Stevens, SWQB, and Andrew Simon, USDA-ARS), early water quality data (Neal Schaeffer).
11/7/02	Review of early SWQB data results (group discussion), introduction of watershed management plan concept (Abe Franklin), updated near-term workplan developed by Nicholas Bugosh, Gary Broetzman, Jimmie Fisher, and Abe Franklin (group discussion).
12/11/02	Request for review of rough draft watershed management plan (Abe Franklin), initial coordination between two states and Southern Ute Tribe to characterize possible nutrient impairment in Animas River (Neal Schaeffer), water quality monitoring updates (Neal Schaeffer and Errol Jensen), project organization and direction (Gary Broetzman).
1/16/03	Updates on watershed management plan and Animas nutrients inter-agency coordination (Abe Franklin and Chuck Wanner), NPDES Phase II presentation (Rich Powell), initial analysis by group of available water quality data to identify water quality problems, discussion of possible Group position regarding sedimentation.
2/19/03	Status reports on Watershed Management Plan (on hold until further progress made) and evolving Animas nutrients study, discussion of group activities related to possible sedimentation impairments, prioritization of streams and water quality problems to be addressed by group.
4/2/03	Discussion of SWQB assessment procedures, possible changes to TMDL regs, proposed changes to State water quality standards, and SWQB monitoring planned for 2003 (Abe Franklin), update of proposed Animas nutrient study (Chuck Wanner), discussion of available data related to sedimentation (Ron Bliesner).

Meeting Date	Agenda Topics
5/7/03	Updates on Animas nutrient study (Chuck Wanner), water quality standards triennial review (Abe Franklin), development of group position regarding sedimentation, and prioritization of streams and water quality problems (with consensus emerging that fecal coliform bacteria in several reaches constitute a potential problem).
6/4/03	Update on Animas nutrient study being planned (Abe Franklin), discussion of sources of fecal coliform bacteria (group).
7/15/03	Animas nutrients update (Chuck Wanner), review of historical bacteria data (Abe Franklin), discussion of objectives of new bacteria monitoring effort (focus on verifying problem, identifying sources secondary), and formation of monitoring plan and business plan committees.
8/19/03	Animas nutrients update (Chuck Wanner), water quality standards revision update (Abe Franklin), reports from monitoring plan and business plan subcommittees, group discussion of funding opportunities for bacteria monitoring effort, update on TMDL status (Abe Franklin).
9/23/03	Animas nutrients update (Chuck Wanner), announcement by monitoring plan subcommittee that US Bureau of Reclamation would conduct a small bacteria study under the Watershed Group's direction, report from business plan subcommittees, discussion of possible fiscal sponsors to manage funds for future monitoring efforts.
10/28/03	Report on Animas nutrients monitoring conducted (Chuck Wanner), update on sedimentation study in progress (Nick Jokay of National Sedimentation Lab), announcement that CWA Sec. 319 funds would not be available for FY2004, report on USBR data collection confirming high levels of bacteria (*E. coli*) in 2003 (Scott Clow).
12/2/03	Report on Animas nutrients initiative for 2004 (Chuck Wanner), status of stream bottom deposit study (Abe Franklin), more detailed review of recent *E. coli* data (Scott Clow), discussion of further monitoring warranted (group), proposed strategies for developing Watershed Management Plan (Abe Franklin).
1/6/04	Discussion and selection of a method for developing the Watershed Management Plan, selection of a fiscal sponsor, presentation of draft marketing document (Chuck Wanner and Paul Montoia) and marketing PowerPoint presentation (Scott Clow) aimed at improving local understanding of bacteria issue and securing funding for monitoring.
2/10/04	Report from Abe Franklin and Aaron Chavez on presentation by Dr. Kevin Oshima on developing techniques for enumerating *cryptosporidia* and viruses, listing decisions to appear in upcoming draft CWA 303(d) List, Chapters 1 and 2 of Watershed Management Plan, outreach strategies.

Meeting Date	Agenda Topics
3/18/04	Draft fiscal sponsorship agreement with San Juan Water Commission, updates on 303(d) List in preparation and TMDL's, Chapter 3 of the Watershed Management Plan, outreach strategies, discussion of 104(b)(3) grant application process to support additional monitoring.
4/22/04	Nutrient assessment on Animas River in NM (Seva Joseph), sedimentation study (Andrew Simon), 303(d) List decisions and TMDL plans (Lynette Guevara), outreach plans, fundraising, and fiscal sponsorship vs. incorporation (group discussion).
5/18/04	Discussion of bacterial source tracking methods being tested in middle Rio Grande (David Hogge (SWQB) and group discussion), selection of fiscal agent, status of presentations to local governments.
6/24/04	Animas River nutrient workgroup reports (Chuck Wanner and Chester Anderson), Chapter 4 and 5 of Watershed Management Plan (group discussion), fundraising and outreach reports (Carl Woolfolk, Paul Montoia, and others)
7/22/04	Revised drafts of Chapters 4 and 5 of Watershed Management Plan (group discussion), bacteria sources, remediation approaches, and monitoring strategies (group discussion), NMED Construction Programs Bureau programs for addressing septic tank issues (Richard Rose), TMDL and Sec. 319 program updates (Abe Franklin).
8/23/04	Discussion of Chapters 4-7 of Watershed Management Plan, draft agreement with potential fiscal sponsor Hub RC and D (group discussion), upcoming monitoring efforts, logistics of preparing a proposal for a Section 319 project (group discussion).
9/22/04	Section 319 project proposal progress (various participants), draft agreement with potential fiscal sponsor Hub RC and D (group discussion), initial observations from river raft trip with bacteria sampling and status of possible additional monitoring (Scott Clow).
10/25/04	Discussion of CWA Section 319 proposal in preparation, reports from Abe Franklin and Scott Clow regarding recent and future bacteria monitoring, discussion about pros/cons of formal organization of San Juan Watershed Group.
12/06/04	Status of review of Sec. 319 proposal (Abe Franklin), discussion of approaches for drafting TMDL's (various participants and Lynette Guevara), Watershed Management Plan review and discussion.

During the second and third meetings, the group drafted as an initial mission "to protect current and future uses of surface waters in the San Juan watershed through identification of water quality concerns and by seeking solutions for problems defined". Four goal statements were also drafted to support this mission:

- Review water quality standards, identify problem parameters, and assist the New Mexico Environment Department, as needed, in developing total maximum daily loads.

- Encourage a balanced approach for bringing problem parameters into compliance; look for implementing best management practices to keep those problems from worsening.
- Develop a comprehensive monitoring strategy.
- Focus on surface water concerns and connected shallow aquifers.

Because NMED's Surface Water Quality Bureau encouraged formation of the San Juan Watershed Group, the Group felt that NMED would be relatively responsive to any information or guidance developed, and so made a decision to focus primarily on waters and portions of the San Juan Basin where NMED has jurisdiction. The Group's interest in possible impairment of the Animas River by nutrients starting north of the State line in Colorado, and participation by personnel from tribal governments with jurisdiction in the Basin, as well as participation by some Colorado residents, demonstrate that the Group takes a boundary-blind watershed approach when doing so can help the Group achieve its mission[2].

The Group also chose to focus initially on the San Juan Basin rather than smaller watersheds within the Basin. This decision was re-affirmed during the December 11 2002 meeting, during which Gary Broetzman proposed to the Group that increased participation from citizens and organizations with more narrow geographic focus (*e.g.*, irrigation ditch associations, neighborhood associations) could be achieved if the Group were to break into smaller groups for each of several areas. Many Group participants at this time had broad geographic jurisdictions (*e.g.*, Federal agency personnel), or were otherwise interested in the "big picture" of water quality in the San Juan Basin, and did not want to attend more meetings (of the smaller groups) in order to stay equally well informed, so the Group's focus has remained on the San Juan Basin as a whole.

The Group has demonstrated that their focus is on water quality concerns of importance to the communities of the San Juan basin, and that these concerns do not necessarily correspond to the water quality problems identified by the New Mexico Environment Department (NMED). For example, all three segments of the San Juan River that were assessed by NMED's Surface Water Quality Bureau (SWQB), and both segments of the Animas River, were listed on the State's "2002-2004 State Of New Mexico §303(D) List For Assessed River/Stream Reaches Requiring Total Maximum Daily Loads (TMDLs)" as being impaired by stream bottom deposits (called "sedimentation/siltation" in more recent documents). As discussed in greater detail in Chapter 4, the San Juan Watershed Group has not reached a consensus regarding whether sedimentation constitute a water quality problem in any of these rivers, and many participants doubt that the State's water quality standard is exceeded, because they view sediment loadings as originating predominantly from natural sources. The Watershed Group expressed this position, and confirmed their desire to be involved in the process of revising the 303(d) List, in a letter to David Hogge (then TMDL coordinator for SWQB) dated May 19 2003. That letter is reproduced in Appendix B.

Data Subcommittee

On several occasions subcommittees worked outside of regular meetings to discuss issues and plan in greater detail than would be appropriate in the meetings of the full group. A data

[2] In the Animas River watershed, the Animas River Stakeholder's Group has been active since 1994, with a focus primarily in Colorado. They can be reached at 8185 CR 203, Durango, CO 81301 or by calling (970) 385-4138.

subcommittee of Steve Austin, Nicholas Bugosh, Paul Martin, Mike Roarke (USGS), Lynette Stevens (chair), Shawn Stout, and Tom Strain initially formed during the November 2001 meeting. These individuals and others made information regarding existing water quality data and planned sampling for 2002 available to Neal Schaeffer, who developed a draft monitoring plan, which the subcommittee had the opportunity to review. Two subcommittee members commented on the draft monitoring plan before it was presented to the full group at the February 2002 meeting.

Workplan Subcommittees

Also during the November 2001 meeting, a small subcommittee (composed of Gary Broetzman, Abe Franklin, and Paul Martin) formed to develop a tentative near-term workplan for the group, which was provided to the group at the January 2002 meeting, and discussed and modified slightly by the group during their April 2002 meeting.

The need to update this workplan was addressed by another small subcommittee (composed of Gary Broetzman, Nicholas Bugosh, Jimmie Fisher, and Abe Franklin) formed during the September 2002 meeting. An updated near-term workplan developed with guidance of this subcommittee was presented to the full group for partial discussion during the November 2002 meeting.

Animas River Nutrients Workgroup

A significant spin-off group formed in December 2002, as a result of initial observations made by Surface Water Quality Bureau staff and area residents in both Colorado and New Mexico regarding potential nutrient impairment of the Animas River. This new group, called the Animas River Nutrients Workgroup, includes several participants of the San Juan Watershed Group (most notably Chuck Wanner of the San Juan Citizens Alliance and Scott Clow of the Ute Mountain Ute Tribe), and personnel from the Southern Ute Indian Tribe, Surface Water Quality Bureau, State of Colorado Water Quality Control Division, and consultant to the Southern Ute Indian Tribe Chester Anderson. Chester Anderson coordinated most technical activities of the workgroup, and Chuck Wanner coordinated fundraising and communication with the San Juan Watershed Group.

The efforts of this group resulted in additional water quality monitoring conducted by several entities using similar methods in the fall of 2003, and again in the fall of 2004. The Animas River Nutrients Workgroup's goal was characterizing nutrient loading and effects within the Animas River from upstream of Durango, Colorado downstream to Farmington.

Monitoring and Business Subcommittees

By July 2003, a consensus had developed that fecal coliform bacteria in the Basin's rivers constitute at least a potential water quality problem that warrants further investigation. Two subcommittees formed during the July 15 2003 meeting to develop a monitoring plan to better characterize concentrations and possibly sources of these bacteria (Nicholas Bugosh, Aaron Chavez, Paul Montoia, Cas Ruybalid, Dave Tomko, and Shawn Williams), and to develop a business plan (Eric Aune, Evert Oldham, Abe Franklin, Ken Stanley) to secure funding for the

monitoring.

Several conference calls and face-to-face meetings of these subcommittees, and a concise request made by Scott Clow to the US Bureau of Reclamation in August 2003, resulted in a small monitoring effort contributed by the US Bureau of Reclamation in September 2003. Interpretation of the results and the nature of any further monitoring have returned as topics of discussion by the full Group, as has activity related to funding this monitoring.

3. WATER QUALITY MONITORING

This section describes the surface water quality monitoring that has been conducted in the San Juan Basin in New Mexico before 2002, in 2002, and in 2003 and 2004, as well as monitoring which is planned or considered warranted for the future in light of remaining questions. The objective is to provide the reader with a sense of what information is available, and to provide starting points for obtaining the information. Interpretations of the data are offered in Chapter 4: Water Quality Problems.

Historical Data and Ongoing Monitoring Programs

Watershed group meetings conducted on October 18 2001 and November 29 2001 included summaries by representatives of several agencies of existing water quality data collected in the San Juan Basin. These and other data are listed below.

Coal Mine Reclamation Program Monitoring

Several companies in the San Juan Basin operate coal mines and periodically monitor surface water quality in and around their mines to comply with permits issued by the New Mexico Energy, Minerals and Natural Resources Department (EMNRD) under the State's Coal Mine Reclamation Program. These data are available from EMNRD's Mining and Minerals Division, which maintains an on-line database of submitted data[3]. The water quality data are referenced by mine, site type (*e.g.*, "surface"), and site name. The mines included in this data source are the Black Diamond, De Na Zin, Gateway, Lee Ranch, La Plata, and San Juan Mines. Descriptions of the sites (e.g., locations, water bodies sampled, etc.) are available from mine contacts (generally available on the EMNRD database) or from EMNRD staff.

BHP Billiton operates the La Plata Mine, the San Juan Mine, and the Black Diamond mine. BHP Billiton has sampled two sites on the La Plata River, and sites on McDermott Wash and its tributaries in the vicinity of the La Plata mine, as well as sites on Shumway and Westwater Arroyos in the vicinity of the San Juan mine, and the data are available on the EMNRD database. BHP Billiton also operates the Navajo Mine in New Mexico, but it is on tribal land and is not under NM Coal Mine Reclamation Program regulation. EPA Region 9 regulates discharges from the Navajo Mine under the NPDES program as described below.

Polycyclic Aromatic Hydrocarbons

In July 1993, the United States Fish and Wildlife Service (USFWS) issued a Biological Opinion on the December 1991, Bureau of Land Management (BLM) Albuquerque District Office's Resource Management Plan/Environmental Impact Statement for oil and gas leasing and development. The Biological Opinion stated that " . . . the ongoing and proposed oil and gas leasing and development activities are likely to jeopardize the continued existence of the Colorado squawfish (name changed to the Colorado pikeminnow) and the Razorback sucker by reducing the likelihood of both the survival and recovery of the species through degradation of

[3] Energy, Minerals and Natural Resources Department, Mining and Minerals Division, Coal Mine Reclamation Program, 1220 South St. Francis Drive, Santa Fe, New Mexico 87505, (505) 476-3413 (www.emnrd.state.nm.us/Mining/CoalMinesQuery/default.aspx)

the aquatic habitat in the San Juan River." In order to define parameters for the study, USFWS and BLM, Farmington Field Office (FFO) agreed to develop a project that would monitor a suite of polycyclic aromatic hydrocarbons (PAHs) they may originate from oil and gas development activities. Water and sediment from approximately twenty-five sites in the San Juan, La Plata and Animas Rivers were sampled every year (except 1999) from 1995 through 2001 (Odell 1997, Wirth 1999, Wirth 2001, and Wirth 2002). Sampling of ephemeral washes was included in 1995 and 1996. Some sampling of discharge pits directly associated with well locations also occurred. A lack of detectable PAH's in the first years of the study resulted in a focus on sampling after storm events in 2000 and 2001.

Independent Monitoring of Low Flow Tests

Arizona Public Service Company staff collected samples of San Juan River water from near the Four Corners Power Plant, to be analyzed for approximately 13 parameters on six dates beginning on January 9 1996, and ending on January 29 1996 (Salisbury 1996). Concurrently, the Bureau of Reclamation conducted a test in which the flow from Navajo Dam was reduced to 250 cubic feet per second (cfs) beginning on January 10, and ending on January 25 (after which the flow was increased again).

Similarly, the City of Farmington collected data for about thirty constituents at three locations on the San Juan River before, during, and immediately after a low flow test conducted in July 2001[4], during which the flow from Navajo Dam was also reduced to 250 cfs.

National Pollutant Discharge Elimination System Data

Entities with Individual National Pollutant Discharge Elimination System (NPDES) permits are divided into domestic wastewater treatment plants (WWTP's) or industrial facilities. In general, WWTP's are required to monitor for fecal coliform bacteria, total residual chlorine, total suspended solids, total dissolved solids, pH, flow, and 5-day biological oxygen demand. Industrial dischargers monitor for a variety of parameters depending on the activity in which the facility is engaged. All individual NPDES-permitted facilities are required to obtain and report effluent samples (and not stream samples).

For compliance sampling inspections (CSIs) performed by SWQB Point Source Regulation Section staff at "major" facilities (those with a design capacity greater than or equal to one million gallons per day), samples are taken from the effluent, with occasional sampling upstream and downstream of the effluent outfall. If a facility discharges directly into the San Juan River or the effluent reaches the river via a tributary, the owners/operators must also perform and report biomonitoring results (in which mortality of *Daphnia* shrimp or fathead minnows is used to measure effluent toxicity). With the exception of CSI results and results from major facilities (which are electronically entered into STORET or the EPA PCS database[5], respectively), sampling data is submitted on paper. All sampling data are maintained on file at the SWQB

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[4] City of Farmington Community Development Department, Water Resources Division (800 Municipal Drive, Farmington, NM 87401).

[5] This database is described on the Internet at www.epa.gov/compliance/planning/data/water/pcsaccess.html. Interested individuals are asked to open a National Technical Information Service account by contacting the U.S. Department of Commerce, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161, (800) 553-6847.

office in Santa Fe[6].

Table 7 lists the wastewater treatment plants that discharge to the San Juan River or its tributaries in New Mexico.

Table 7: WWTP's Discharging into the San Juan Basin or Tributaries

NPDES No.	Permittee	Biomonitoring?
NM0028142	Bloomfield Municipal Schools	No
NM0029319	Central Consolidated Schools -	Yes
NM0029025	Harper Valley Subdivision	Yes
NM0020168	Aztec	Yes
NM0020770	Bloomfield	Yes
NM0020583	Farmington	Yes
NM0030473	San Juan County – McGee Park	Yes

Table 8 lists industrial facilities that discharge to the San Juan River or its tributaries. As noted above, the parameters that require monitoring in the NPDES permits vary according to the industrial activity. These facilities generally monitor TSS, TDS, pH, and aluminum. Some facilities may also monitor for a suite of metals, radionuclides, and flow, and two perform biomonitoring.

Table 8: Industrial Facilities Discharging to the San Juan River or Tributaries

NPDES No.	Permittee	Biomonitoring?
NM0029432	Yampa Mining Co. - De Na Zin	No
NM0029581	Lee Ranch Coal - Lee Ranch Mine	No
NM0028746	San Juan Coal - San Juan Mine	No
NM0029505	San Juan Coal - La Plata Mine	No
NM0027995	Four Corners Materials, Inc. - Oldcastle SW Group, Inc.	Yes
NM0028606	Public Service Company of New Mexico – San Juan Generating Station	No
NM0030317	Blanco MDWA - Drinking Water Plant (Pending)	Yes

The facilities listed in Table 9 are now in the jurisdiction of EPA Region 9. The data associated with their permits are kept by the individual facilities and EPA Region 9. SWQB has historical data for some of these permittees, and still receives monitoring reports for a few.

[6] Data are available upon request from the New Mexico Environment Department, Surface Water Quality Bureau, Point Source Regulation Section (PO Box 26110, Santa Fe, NM 87502).

Table 9: NPDES-Permitted Facilities in EPA Region 9

NPDES No.	Permittee
NM0000019	Arizona Public Service Co., Four Corners Plant
NM0028193	Utah International (BHP), Navajo Mine
NM0020630	Navajo Tribal Authority, Crownpoint
NM0020621	Navajo Tribal Authority, Shiprock WWTP
NM0020991	BIA - Pueblo Pintado
NM0020800	BIA – Nenahnezad
NM0021016	BIA - Lake Valley
NM0025640	Navajo Irrigation Project (Pending)

The lists above do not include facilities with general permits (*e.g*., NPDES Storm Water Multi-Sector General Permit for Industrial Activities), or facilities within the San Juan Basin in Colorado. There are approximately seven facilities in Colorado with wastewater discharge permits, the largest being the Durango and South Durango wastewater treatment plants, which discharge to the Animas River. An additional facility with a pending NPDES permit is the concentrated animal feeding operation on Navajo Nation land in the Gallegos Canyon watershed.

United States Geological Survey Data

The USGS Water Resources Division publishes annual reports containing a wide variety of water quality and other hydrologic data (for examples see Byrd and others 2003, Byrd and others 2002, Ortiz and others 2001, Cruz and others 1994). These data (available on the Internet at waterdata.usgs.gov/nwis) are expansive, covering the period since 1900 and including very many chemical constituents (metals, nutrients, ions, organic compounds, etc.), biological measurements (including bacteria numbers and measurements related to nutrient enrichment), and physical attributes (*e.g*., suspended sediment). These data constitute the major resource for understanding water quality trends in the San Juan Basin over a period of decades, but some desired comparisons (*e.g.* between sites) may be difficult because not all parameters have been sampled every year, and the parameters and sites which have received the greatest focus have changed over time.

The USGS has also published many reports using these and other data[7]. Examples are Blanchard and others 1993, Thomas and others 1996, Thomas and others 1998, and Thorne 1993. The USGS is currently completing a study of upland erosion in the Largo Canyon watershed, in cooperation with BLM (Matherne, in publication). This study, along with GIS data maintained by BLM tracking acres of surface disturbance associated with gas and oil development (summarized in Anonymous 2002c), may be useful for estimating the anthropogenic component of sediment loading to the San Juan River.

[7] Many publications are listed on the Internet at nm.water.usgs.gov/publications.htm. The list of available reports, or the reports themselves, may also be obtained by contacting USGS Information Services, Box 25286, Denver Federal Center, Denver, Colorado 80225-0286. Their fax number is 303-202-4695. Call 888-ASK-USGS (888-275-8747) for more information and prices.

EPA's Water Quality Data Storage and Retrieval (STORET) System
This system is maintained by EPA and is accessible on the Internet at www.epa.gov/storet/dbtop.html. Currently, two separate databases are maintained, one archiving data collected before 1999 (Legacy STORET), and one with more recent data (Modernized STORET). Both databases rely on many organizations in addition to EPA to supply data. USGS does not participate in the STORET program. Modernized STORET has been accessible for a relatively short period and many traditional contributors have yet to upload significant quantities of their data to this database, or EPA has yet to accession the data.

Legacy STORET provides convenient access to the data collected and used by SWQB to prepare the reports cited above, along with data collected by USEPA and the National Park Service. The data collected by the National Park Service (which manages Chaco Culture National Historical Park and Aztec Ruins National Monument) that are available from STORET are primarily from outside the area addressed by this document.

United States Bureau of Reclamation Data
The USBR has collected water quality data over the years primarily to support planning of specific projects. Most of the data are organized in a database accessible to USBR staff[8]. The parameters included have varied depending on the nature of the proposed project. Depending on the nature of the proposed project, suspended sediment, trace elements, ions, and radionuclides have been monitored. Most data are from the Animas River in New Mexico and Colorado (for example, as summarized in Anonymous 2000), with fewer data collected from the San Juan River. The U.S. Fish and Wildlife Service has had responsibility for organizing water quality data related to the San Juan Recovery Implementation Program.

Additional information that may aid understanding the causes of some water quality problems in the San Juan Basin include a set of color infrared digital orthophotos and registered GIS data depicting riparian vegetation and wetted area along the San Juan River between the Animas River and Navajo Dam developed by USBR (Anonymous 2002b).

Ute Mountain Ute Water Quality Monitoring
Monitoring by the Ute Mountain Ute Tribe in the middle San Juan Basin has included surface and ground water measurements for major ions, nutrients, heavy metals, and coliform bacteria[9]. Ute Mountain Ute lands include approximately 100,000 acres in New Mexico north of the San Juan River near the Hogback (Figure 1), and also include a reach the San Juan River approximately thirty-five miles downstream of the area emphasized in this Plan. Sampled water bodies include Shumway and Westwater Arroyos, the La Plata River, and the San Juan River and Mancos Creek downstream of the Hogback. The data collected will likely be useful for helping to understand bacteria loading from upland watersheds (*e.g.*, Shumway and Westwater Arroyos) and for understanding water quality of the La Plata River as it enters New Mexico.

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[8] For more information, contact the United States Bureau of Reclamation, Four Corners Division, Environmental and Planning Group, 835 East 2nd Ave., Suite 300, Durango, CO 81301.
[9] Further inquiry should be made to Scott Clow, Water Quality Specialist, Ute Mountain Ute Tribe, P.O. Box 448, Towaoc, CO 81334. Phone: (970) 564-5431

Navajo Nation Environmental Protection Agency Data
The Navajo Nation EPA (NNEPA) has sampled four sites in arroyos tributary to the San Juan River (including the Chaco River, Gallegos Canyon, Ojo Amarillo Canyon, and Blanco Canyon) for the past several years, through spring of 2004[10]. Samples are analyzed for priority pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium and zinc), standard nutrients, and field parameters (such as temperature, pH, conductivity, dissolved oxygen, and turbidity). In addition, fecal coliforms, gross alpha, and uranium (as a metal) are measured at Gallegos and Ojo Amarillo Washes. NNEPA also monitors (primary pollutant metals and fecal coliform bacteria) Morgan Lake, a body of water associated with the Four Corners Power Plant (on the Navajo Nation) that is popular among windsurfers.

The NNEPA Pesticides Program supported the "Upper Fruitland Seepage Studies Project", with a final report dated December 15, 2003. This study examined pesticides in groundwater at over 20 sites, primarily using immunoassays.

Surface Water Quality Bureau Studies
SWQB conducted water quality surveys in the San Juan Basin in 1984 (Smolka 1985), 1989 (Smolka 1990), 1990 (Smolka 1991), and 1991 (Smolka 1992, Davis 1992)[11]. A more recent intensive survey was conducted in 2002, with follow-up monitoring in 2003, as described below. The current policy of the Surface Water Quality Bureau is to survey water quality in all watersheds in the state, every eight years.

San Juan River Basin Recovery Implementation Program Data
The San Juan River Basin Recovery Implementation Program (RIP) is coordinated by the U.S. Fish and Wildlife Service (USFWS) to support recovery of the razorback sucker and Colorado pikeminnow in their designated critical habitats. The designated critical habitat of the razorback sucker is the San Juan River and adjacent floodprone areas downstream of the Hogback (to Lake Powell) and that of the Colorado pikeminnow is the San Juan River downstream of the Animas River (to Lake Powell). To better understand the factors currently preventing recovery of these two endangered species, and to develop strategies for their recovery, a wide variety of data have been collected by USFWS, USBR, BIA, and their contractors (Anonymous 2001, Anonymous 2002a, Bliesner and Lamarra 2000, Holden 1999, Propst and others 2000, Simpson and Lusk 1999). A very thorough review of water quality data was provided by Abell (1994) through this program[12]. Much of the monitoring that has taken place relates to fish habitat, and may be

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[10] Steve Austin of NNEPA (505-368-1037) is the contact for determining in greater detail what data are available. Contact Yolanda Benally at 928-871-7811 regarding availability of the Upper Fruitland Seepage Studies Project report. Requests for other data should be made formally to Patrick Antonio, NNEPA, PO Box 339, Window Rock, AZ 86515, (928) 871-7185.

[11] These reports are available upon request from the New Mexico Environment Department Surface Water Quality Bureau (P.O. Box 26110, Santa Fe, NM 87502, 505-827-0187). The data are provided within the reports, and are also available in STORET.

[12] This report is available on the Internet at southwest.fws.gov/sjrip/progdocs.html. Hard copies of Volume I of the report are also available from Joel D. Lusk, Senior Environmental Contaminants Specialist, United States Fish and Wildlife Service, New Mexico Ecological Services Field Office, 2105 Osuna NE, Albuquerque, New Mexico 87113-1001, (505) 761-4709, joel_lusk@fws.gov.

relevant to determining whether the State's narrative sedimentation standard is exceeded in the San Juan River. Some of the monitoring has focused on trace compounds (primarily heavy metals and organochlorines) and their possible effects on the fish (see also the section above on polycyclic aromatic hydrocarbons). The focus of this monitoring effort extends upstream in the San Juan River to Navajo Dam, but generally has not included the Animas River.

2002 Monitoring

The data listed above provide a basis for identifying water quality problems, at least in a general sense and over a period of decades. However, the Surface Water Quality Bureau required recent data to develop updated information regarding water quality.

The USGS, RIP, and City of Farmington water quality monitoring programs extended into 2002, and the San Juan Watershed Group (primarily the data subcommittee) worked with Lynette Stevens and Neal Schaeffer to develop a water quality monitoring plan to implement in 2002. In addition to guiding monitoring activity by SWQB, that plan avoided duplication of effort among participating agencies in an effort to ensure that sufficient data would be available for making determinations of water quality impairment (or lack of impairment). As the agency with assessment of surface water quality as a primary mandate, and which would be conducting much of the monitoring, SWQB drafted this monitoring plan with the goal of gaining a comprehensive (albeit limited to drought conditions of 2002) description of water quality in the Basin by identifying sites or parameters of interest that would not already be sampled by another agency. This plan was reviewed by the data subcommittee and was available for review by the full group before the February 2002 meeting, at which Neal Schaeffer presented the plan. A spreadsheet and map in Appendix C summarize this plan. The sampling methods used are outlined in a Quality Assurance Project Plan (QAPP)[13] prepared by SWQB to standardize procedures and facilitate their review.

The monitoring plan was implemented with a few minor changes[14]. Generally, the changes resulted in an expanded study through addition of sites or parameters. Because permission to access a site 300 meters downstream from Aztec's wastewater treatment plant was not obtained, a new site was selected on the Animas River at Flora Vista.

Special attention was paid in the 2002 monitoring plan to locations and parameters where impairment has been detected or suspected in the past (especially those reaches on the State's Clean Water Act 303(d) list), but the study also included consideration of suspected impairment not previously considered by SWQB (e.g., MTBE in the Animas River), and some sampling was conducted without any expectation of detecting impairment. This last category was included to verify that waters are unimpaired for those parameters, and to provide information regarding water quality trends.

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[13] This document can be downloaded (at www.nmenv.state.nm.us/swqb/SWQB_QAPP-2002.pdf), or is available upon request from SWQB at PO Box 26110, Santa Fe, NM 87502.

[14] Data collected by the Surface Water Quality Bureau are available upon request by writing P.O. Box 26110, Santa Fe, NM 87502 or calling 505-827-0187. The ambient toxicity data are also available on the internet at www.epa.gov/earth1r6/6wq/ecopro/watershd/monitrng/toxnet/nm.pdf.

2003 Monitoring

Water quality data collected in 2002 revealed a need for more focused monitoring of several parameters. Additionally, SWQB and a cooperator, the National Sedimentation Laboratory (a Division of the U.S. Agricultural Research Service) initiated a study of sediment transport and accumulation in the San Juan and Animas Rivers in 2003. Each of these monitoring efforts is briefly described below.

Thermographs

Several temperature exceedences in the Animas River at the state line and at Aztec in 2002 prompted the deployment of thermographs, in the air and in the water, at Cedar Hill and Aztec, to record air and water temperatures every hour from July 14 2003 until August 21 2003. These additional data were necessary to apply SWQB's assessment protocol for temperature[15].

Animas River Nutrient Assessment

Field observations by SWQB staff indicating possible nutrient enrichment during 2002 prompted collection of additional data in 2003. These data include measurements of nutrient concentrations, algae abundance, dissolved oxygen and pH, limiting nutrient analysis, algal bioassays (algal growth potential analyses), and benthic macroinvertebrate data and were used to apply SWQB's assessment protocol for plant nutrients. As described in Chapter 2, this was part of a coordinated, watershed-based study that was conducted in Colorado and on Southern Ute lands as well.

Sedimentation Assessment

Surface Water Quality Bureau and National Sedimentation Laboratory (NSL) staff conducted bed material sampling, rapid geomorphic assessments, and benthic macroinvertebrate sampling at numerous locations on the Animas and San Juan Rivers in 2003 to provide data for use in developing an assessment protocol for impairment by sedimentation in these and possibly other large southwestern rivers. This work was supported with a purpose-specific grant from EPA. These data and preliminary analyses (including tentative listing and delisting rationales) were presented by Andrew Simon and Lynette Guevara at the April 22 2004 Watershed Group meeting. A report from NSL detailing their findings, and suggesting a means for discriminating between natural (reference) conditions, and impacted (or impaired) conditions, was completed in August 2004[16].

Bacteria Monitoring

The monitoring conducted in 2002 resulted in several exceedences of both the current criteria for fecal coliform and of the proposed criteria for *E. coli* at several sites on the San Juan, Animas, and La Plata Rivers. Several members of the Watershed Group suspected that the exceedences

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[15] SWQB assessment protocols are found in the *State Of New Mexico Procedures For Assessing Standards Attainment for the Integrated §303(D) /§305(B) Water Quality Monitoring and Assessment Report: Assessment Protocol*, available on the Internet at www.nmenv.state.nm.us/swqb/protocols/AssessmentProtocol2003_v6.pdf, or upon request from SWQB at PO Box 26110, Santa Fe, NM 87502.

[16] This report is available on the NMED web site at www.nmenv.state.nm.us/swqb/Projects/SanJuan/SBD/SJR_REPORT_post_review.pdf.

were caused in part by the unusually dry conditions of 2002, and they further observed that some of the highest numbers corresponded to precipitation events near the end of a prolonged dry period. It was suggested that if sufficient data were collected to apply the geometric mean criteria (which are lower than the single sample criteria but require five samples to be collected within a thirty-day period), that fewer exceedences might result. Further, it was observed that the Animas River downstream of Aztec would have fewer exceedences were the proposed *E. coli* criteria to replace the existing fecal coliform criteria. (This change is being proposed by the Surface Water Quality Bureau to the Water Quality Control Commission, at EPA's encouragement, because the single species *E. coli* is more strongly correlated to illness in swimmers than is the more general fecal coliform group of bacteria.) The level of impairment and the implications of a change in the water quality standards were not clear from the 2002 data alone, so the San Juan Watershed Group developed a proposal to essentially repeat the work conducted in 2002 (sampling the same sites for both *E. coli* and fecal coliform), but to sample five times within a thirty day period. The La Plata and Animas Rivers were not included in this repeat study. Dialogue between Scott Clow and Errol Jensen resulted in the U.S. Bureau of Reclamation conducting this sampling in September 2003. A miscommunication during the study resulted in all samples being analyzed for *E. coli*, however, and none were analyzed for fecal coliform.

2004 Monitoring

Animas River Nutrient Assessment

The Animas River Nutrient Work Group repeated the sampling conducted in 2003 in October 2004. In addition to monitoring periphyton biomass, samples were also collected for total nitrogen and phosphorus for all sites (one of the problems from 2003 was the lack of TN and TP figures for all sites). This year one lab was used to analyze samples from all sites and split samples were sent to other labs used by NM and SUIT. In 2004 an additional site was added near Silverton, Colorado in the upper basin. Stream flow data were collected at several sites in conjunction with sampling. All of the partners in the 2003 effort continued in 2004. The U.S. Bureau of Reclamation, Cities of Farmington and Durango, and Colorado's Southwest Water Conservation District participated in funding the effort. Both states, the Southern Ute Indian Tribe and the Ute Mountain Tribe contributed in-kind donations. Data will probably be available on the Internet in early 2005.

Bacteria Monitoring

In 2004, two small sampling efforts were conducted. The smaller of the two constituted collection of samples for *E.coli* and fecal coliform enumeration from the Animas River at a site less than 2 miles downstream of the state line, at Cedar Hill under the Highway 550 bridge, and in Aztec under the Chaco Street bridge. This sampling was conducted on August 24 in response to a health advisory issued on July 29 by the Southern Ute Indian Tribe for the Animas River just upstream of New Mexico.

A larger sampling effort focused on the San Juan River on September 20 and 21, with a few samples collected from the lower Animas River on September 21. The San Juan and several tributaries and other inflows were sampled at numerous locations from a raft between Blanco and

Lee Acres. The Animas was sampled at Cedar Hill near the highway 550 bridge, in Aztec at Riverside Park, and at the Flora Vista bridge. Samples were analyzed for total coliform and *E. coli* using the IDEXX bacteria enumeration system. The results of this sampling were undoubtedly affected by a storm system that brought persistent rains to much of the region the night before sampling began and again the night before the second day of sampling[17].

Future Monitoring

The sections above briefly describe data collected through 2004. Below, sections on water quality problems and possible solutions to these problems describe what these data show. In several cases, collection of additional data is warranted to better understand the sources, geographic extent, persistence, and seasonality of possible water quality problems. These data needs are described in greater detail in appropriate sections below.

[17] A report describing the 2004 sampling on the San Juan in greater detail, with results and some interpretation, is available on the Internet at www.nmenv.state.nm.us/swqb/wps/San_Juan/SanJuanRiver-2004BacteriaSamplingReport.pdf.

4. WATER QUALITY PROBLEMS

Water quality problems can be very broadly defined. A problem that impedes one person's use of a stream may not be a problem for someone else. To provide a somewhat objective framework, the water quality data summarized in the section above are primarily compared in this section to the state's Water Quality Standards.

The Surface Water Quality Bureau has identified all parts of the San Juan, Animas, and La Plata Rivers as being impaired by one or more pollutants, and has revised the Clean Water Act Section 303(d) List based on recent and other available data[18]. Table 10 summarizes the listings in the 2004-2006 303(d) List (X's, including changes made during a second revision of the list in September 2004), and the listings found in the 2002-2004 303(d) List for comparison (shaded). Table 11 lists the uses of San Juan Basin streams designated in New Mexico's water quality standards, and indicates whether those uses are being met, as inferred from available water quality data. The information in Table 11 was taken from the 2004-2006 State of New Mexico Integrated Clean Water Act §303(d) List and §305(b) Report.

The designation and attainment of primary and secondary contact uses depicted in Table 11 warrant some explanation. Primary contact, which may include swimming, rafting, or kayaking (activities with a reasonable chance of ingesting small amounts of river water), is clearly an existing use in of most of the perennial waters of the San Juan Basin. The New Mexico Water Quality Control Commission has recognized this use only in Navajo Reservoir, but has avoided recognizing this use elsewhere in the Basin apparently as an issue of liability. That is, the WQCC does not wish to endorse potentially hazardous activities. Instead, the related designated use for most waters is secondary contact, which may include wading or angling (activities with less likelihood of ingestion). However, the water quality standards have generally been established to protect primary contact, including a single sample criterion of 400 colony-forming units per 100 mL in most streams of the San Juan Basin. The designation of secondary contact as a use of most waters in the San Juan Basin, and the non-attainment of that use in several stream reaches, is reflected in Table 11. In each case, fecal coliform bacteria in excess of state standards intended to protect primary contact is the cause of non-attainment.

Some members of the San Juan Watershed Group have raised concerns that sampling in 2002, which affected the 2004-2006 303(d) List, may not have provided representative data, because of drought conditions that year. Additional sampling for bacteria, nutrient impairment, and temperature in 2003 were consistent with more preliminary observations made in 2002. Some listings were supported by earlier data (1998-2001), and except where noted otherwise below, the San Juan Watershed Group agrees that the water quality problems identified in this section warrant further characterization at a minimum, and in some cases warrant more immediate efforts to reduce pollutant loading.

[18] The Integrated 2004-2006 CWA §§303(d)/305(b) List and related documents are available on the Internet at www.nmenv.state.nm.us/swqb/.

Table 10: San Juan Basin streams on State of New Mexico 303(d) List. Shaded = 2002-2004 List, X = 2004-2006 List.

New Mexico Segment	Sediment-ation/Silt-ation	Turb-idity	Fecal Coli-form	Plant Nutri-ents	Temp	Dissolved Oxygen	Acute Tox-icity	Se	Fish tissue Hg
San Juan River from Largo Canyon upstream to Navajo Dam									X
San Juan River, Animas River to Largo Canyon	X		X				X (water)		X
San Juan River, Hogback to confluence w/ Animas River			X						X
Animas River from Estes Arroyo (at Aztec) to NM-CO border					X				
Animas River from San Juan River to Estes Arroyo			X	X			X (sedi-ment)		
LaPlata River from San Juan River to McDermott Arroyo	X		X			X			
LaPlata River from McDermott Arroyo to CO border			X			X			
Gallegos Canyon								X	
Navajo Reservoir									X
Lake Farmington									X

Table 11: Designated use support of San Juan Basin streams. Source: 2004-2006 State of New Mexico Integrated Clean Water Act §303(d) and §305(b) Report. Shading indicates that the use applies to that water body; X's indicate non-attainment; N indicates that insufficient data were available to assess use attainment.

New Mexico Segment	Livestock Watering	Wildlife Habitat	Irrigation	Irrigation Storage	Industrial Water Supply	Industrial Water Storage	Municipal Water Supply	Municipal Water Storage	Domestic Water Supply	Secondary Contact	Primary Contact	Limited Warmwater Fishery	Warmwater Fishery	Marginal Coldwater Fishery	Coldwater Fishery	High Quality Coldwater Fishery
Navajo River	N	N	N							N					N	
Los Pinos River	N	N	N							N					N	
San Juan River, Hogback to confluence w/ Animas River										X			X	X		
San Juan River, Animas River to Largo Canyon										X				X		
San Juan River, Largo Canyon to Navajo Dam																X
Animas River from Estes Arroyo (at Aztec) to NM-CO border															X	
Animas River from San Juan River to Estes Arroyo										X			X	X		
LaPlata River from San Juan River to McDermott Arroyo										X		X		X		
LaPlata River from McDermott Arroyo to CO border										X		X		X		
Jackson Lake	N															
Gallegos Canyon		X														
Shumway Arroyo																
Navajo Reservoir													X		X	
Lake Farmington									N				X			
Butler Street Reservoir	N	N														

Sedimentation

The report prepared by the National Sedimentation Lab, and earlier reports, identified Largo Canyon as a major source of fine sediment being deposited in an impacted reach of the San Juan River from Largo Canyon downstream to the Animas River. The NSL report also identified operation of Navajo Dam as a management effect that allows the sediment to accumulate beyond what would occur under a natural flow regime (and without the dam). Although Navajo Dam virtually eliminates the sediment load from the watershed upstream of the dam, it also reduces peak flows in the spring, thus reducing the ability of the San Juan River to transport its sediment load. The report did not identify sources of sediment or contributing land-use activities in the Largo Canyon watershed or other watersheds, nor did it state whether the sediment loads are unnatural. SWQB interpreted this report and past reports to determine that the segment of the San Juan River from Largo Canyon downstream to the Animas River exceeds the State's narrative water quality standard for stream bottom deposits (called sedimentation/siltation in the 2004-2006 303(d) List), and that the San Juan River upstream and downstream of this segment, and both assessed segments of the Animas River, do not exceed the standard. The lower portion of the La Plata River was also found to exceed the standard. These decisions resulted in some additional changes to the 2004-2006 303(d) List, which was opened for a second public comment period in September 2004. The Water Quality Control Commission subsequently approved the changes.

The paragraph above describes the positions of the State of New Mexico (acting through the WQCC) regarding impairment (and lack of impairment) of San Juan Basin streams by sedimentation. The San Juan Watershed Group has not developed a consensus regarding the accuracy of these positions.

Turbidity in the High Quality Trout Waters

The San Juan River between Largo Canyon and Navajo Dam (which has a designated use of high quality cold water fishery) was on the 2002-2004 303(d) List based on a few exceedences of the water quality standard observed by SWQB prior to 1998. More recently, SWQB staff located data for 143 turbidity measurements collected between 1994 and 2003 by SWQB, USBR, USFWS, and USGS and compared them with the criterion of 10 NTU. There were 21 out of 143 exceedences in this data set (14.7%). The mean of the measurements was 6.8 NTU, while the median was 4.8 NTU. According to the assessment protocol used by SWQB, turbidity does not impair the use of this segment as a high quality cold water fishery, so the segment was "delisted" in the 2004-2006 303(d) List.

Fecal Coliform Bacteria

Data collected by USBR in 2000 and 2001, and data collected by SWQB in 2002, indicated that the single sample fecal coliform criterion of 400 colony forming units per 100 mL (CFU/100mL) was exceeded ten times (out of 26 samples) in the San Juan River from the Hogback upstream to the Animas River, and eleven times (out of 41 samples) in the San Juan River from the Animas

River upstream to Largo Canyon. The single sample criterion of 100 CFU/100mL was exceeded two times (out of eighteen samples) in the San Juan River from Largo Canyon to Navajo Dam. These data were sufficient for SWQB to retain the middle reach of the San Juan River on the 2004-2006 303(d) List, and to add the lower reach.

In the Animas River upstream from the San Juan River to Estes Arroyo (in Aztec), SWQB observed two exceedences of the single sample fecal coliform criterion of 400 cfu/100 mL out of thirteen samples collected in 2002. These data were sufficient for SWQB to add this lower reach of the Animas River to the 2004-2006 303(d) List. The numbers observed were not high (460 CFU/100mL at most). Also, the Water Quality Control Commission may revise New Mexico's Water Quality Standards pertaining to bacteria in 2004, by discarding the fecal coliform criteria and adopting new criteria for *Escherichia coli*. Under the proposed *E. coli* criteria, this reach of the Animas would not be listed as impaired based on currently available data.

The single sample fecal coliform criterion of 400 cfu/100 mL was exceeded five times (out of eleven samples collected by SWQB in 2002) in the La Plata River, leading to the addition to the Draft 303(d) List of this stream also.

In cooperation with the San Juan Watershed Group, USBR collected additional samples from the San Juan River for five consecutive days (September 29 – October 3) in 2003 for analysis for *E. coli*. These samples were collected from seven sites sampled by SWQB in 2002, and confirmed high bacteria numbers in the San Juan River.

Abe Franklin, Scott Clow, and Tom Rice conducted a brief survey of the San Juan from the Highway 64 Bridge at Blanco to McGee Park in September 2004, during which they collected numerous samples from the river and selected inflows. This survey differed from earlier surveys by the density of sampling. Like the sampling effort in 2003, these samples were affected by a regional storm system. Three samples were also collected from the lower Animas (by Ken Stanley) at this time, and Abe Franklin collected samples from three sites on the upper Animas in New Mexico in August 2004.

During the May 7 2003 meeting, the San Juan Watershed Group prioritized water quality problems by stream segment, and arrived at a consensus that the fecal coliform bacteria and *E. coli* numbers in the San Juan River from the Hogback to Largo Canyon, and in the lower Animas River, constitute the highest priority water quality problems to address in the San Juan Basin. The lower Animas was assigned high priority despite relatively low bacteria numbers because of it's potential for degradation and because it is valued as a recreational amenity and community resource by several people attending that meeting. Bacteria in the San Juan River upstream of Largo Canyon, in the upper Animas River, and in the La Plata River were assigned a medium priority.

The fecal coliform data collected in 2002 (which were collected periodically from March through late October) suggest that bacteria numbers increase with distance downstream, and high numbers (in excess of current or proposed criteria) can occur at any time of year. The highest numbers correspond to summer or fall precipitation events. Available data from all recent years strongly suggest that Largo Canyon is a significant contributor when it is flowing. Kutz Canyon

appeared to have contributed sufficient *E. coli* to increase the levels in the San Juan in September 2004. Relatively large increases between sites on the San Juan (indicating reaches with relatively high bacteria loading) were also noted between the Bollack and Bisti bridges, and the Bisti and Fruitland bridges. During the August 2004 sampling of the upper Animas River in New Mexico, *E. coli* and fecal coliform levels were quite low. During the September sampling of the lower Animas River, *E. coli* numbers were elevated (in excess of proposed criteria), but lower than the levels in the San Juan upstream of the Animas on the same day (fecal coliform was not enumerated). The La Plata, though not sampled at that time, may be an important contributor of bacteria to the San Juan. Some of the 2002 data indicated a minor decrease in bacteria numbers between the Bloomfield Bridge and a site downstream of Kutz Canyon (contrary to observations in September 2004), and another decrease near the lower end of the studied portion of the San Juan River between the Fruitland Bridge and the Hogback.

The Animas River, which was sampled on different days than the San Juan in 2002 and was sampled most intensively at the Colorado state line, in Aztec, and at Flora Vista, generally had much lower bacteria numbers than did the San Juan. The data indicate a larger increase in bacteria loading between Aztec and Flora Vista than between Aztec and the state line.

Among the potential sources of bacteria are poorly maintained or improperly installed (or missing) septic tanks, livestock grazing of valley pastures and riparian areas, upland livestock grazing, and wildlife (such as geese, which are numerous in some areas). Receiving less discussion but nonetheless present are domestic dogs and cats. Scott Clow and Nicholas Bugosh both reported very high fecal coliform numbers in water sampled from ephemeral drainages flowing south to the San Juan River west of the La Plata River (such as Shumway Arroyo), which drain a sparsely vegetated area with little permanent settlement and some livestock grazing. The September 2004 sampling effort demonstrated that ephemeral flow from sparsely populated watersheds can indeed increase bacteria levels in the San Juan River. The effect of Largo Canyon was very dramatic, and Kutz Canyon also seemed to increase *E. coli* levels in the San Juan somewhat. These observations (which are described in greater detail in Chapter 3) indicate that at least some of the bacteria loading does not originate from septic tanks or other human activities (or natural sources) near the river. Some other tributaries and other inflows had high levels of *E. coli* during the September 2004 survey, but insufficient flow to have a noticeable effect on the San Juan. These contributions may sustain high levels in the San Juan, however. Other tributaries and inflows had relatively low levels of *E. coli*.

The area between Blanco and Bloomfield is sparsely populated relative to other parts of the San Juan River valley, but livestock grazing of irrigated pasture and riparian areas is common. The bacteria loading from Largo Canyon (and other ephemeral streams) probably originate almost entirely from a combination of livestock and wildlife, the feces of which presumably contain viable *E. coli* and other fecal coliforms that are carried downhill in surface runoff. Livestock and wildlife both probably spend most of their time within watercourses, where food and cover is more abundant, increasing the likelihood that their waste will be transported by runoff. Directly on the La Plata River between La Plata and the state line, a livestock feeding and holding area exists which, though small enough to not be recognized as a concentrated animal feeding operation requiring a discharge permit, probably contributes significant bacteria loading to the La Plata River. Between the bridge on the Bollack Ranch and the Bisti Bridge, where relatively

high loading also is evident, lie several potential sources of bacteria including unsewered portions of Farmington, urban runoff, irrigated pasture, and wildlife (especially geese). These potential sources are also found between the Bisti and Fruitland Bridges, which also bracket the unsewered communities of Kirtland and most of Fruitland. Beyond these generalities, little analysis has been attempted to identify sources of bacteria, and these data alone are probably insufficient to identify all sources.

Plant Nutrients and Dissolved Oxygen

SWQB collected data in 2002 to assess whether the La Plata River is impaired by plant nutrients, and found insufficient levels of algae or other indicators (except dissolved oxygen) to support this listing, so the La Plata River is not found on the 2004-2006 303(d) List for nutrients. However, this assessment (which utilized hourly measurements of dissolved oxygen and pH made with continuous recording devices) demonstrated that dissolved oxygen concentrations dipped below the criterion of 6.0 mg/L 62% of the time under the bridge near LaPlata, and 22% of the time near the USGS gage near Farmington, so the La Plata River was added to the 2004-2006 303(d) List for dissolved oxygen.

The data from the Animas River and qualitative observations made by Neal Schaeffer and other SWQB staff in 2002, indicated that the Animas River may have been impaired by plant nutrients. As insufficient data were collected to make this assessment in 2002, the Animas River was studied again in 2003 regarding nutrients. Other organizations and individuals had made similar observations in Colorado, and the joint effort described in Chapter 2 produced a data set for the Animas River watershed in New Mexico and Colorado that is still being analyzed and expanded upon. Sufficient indicators were available for SWQB to add the Animas River below Aztec to the 2004-2006 303(d) List. As presented by Seva Joseph of SWQB during the March 18 2004 Watershed Group meeting, these indicators include high dissolved oxygen levels (produced by photosynthesizing algae), high ash free dry matter and chlorophyll a (measures of algae abundance), and concentrations of nitrogen and phosphorus sufficient to support abundant algae. Fewer indicators of nutrient enrichment were present for the Animas River upstream of Aztec, and this reach was not listed as impaired by nutrients.

During the May 7 2003 meeting, the San Juan Watershed Group prioritized water quality problems by stream segment, and arrived at a consensus that the indications of nutrient enrichment in the Animas River (upper and lower segments) and La Plata River represent a high priority water quality problem from the perspective of agriculture (at least partly because of reports from Jimmie Fisher that nuisance algae effects irrigation negatively). Nutrient enrichment was also suspected to impart an off flavor (and odor) to drinking water taken from the Animas River, and (along with low dissolved oxygen concentrations) to negatively affect aquatic life in the La Plata River, and the group assigned medium priority to these problems. It should also be noted that, although the Surface Water Quality Bureau has drawn a conclusion of impairment of the lower segment of the Animas, other participants in the Animas River Nutrients Workgroup felt that the listing in the 2004-2006 303(d) List was premature, because the full Workgroup has not completed analysis of the data collected in 2003 and 2004 that may provide additional relevant information.

The likely sources of nutrients include municipal point sources (wastewater treatment plants in Aztec and Durango, Colorado), poorly maintained or improperly installed (or missing) septic tanks, livestock grazing of valley pastures and riparian areas, upland livestock grazing, wildlife (such as geese, which are numerous in some areas), and erosion of nutrient-rich soil into the river from banks and adjacent floodplains. Whether nutrient loading produces a problem with nuisance algae is partly dependent on temperature and shading of the water, which are influenced by channel morphology and riparian vegetation. A narrower, deeper channel has less surface area exposed to the sun, and will be shaded more by riparian vegetation. Levee construction (common in the Animas River valley) tends to maintain wider, shallower channels and may inhibit establishment of large trees near the water's edge. Unmanaged grazing of riparian areas prevents substantial growth of trees and shrubs, and may affect channel morphology by weakening banks.

While these management effects are undoubtedly present along the Animas River, it is important to note that the long term trend in the Animas River valley seems to be primarily one of recovery following the period of intense grazing and possible climate change near the end of the 1800's. As recently as 1950, aerial photographs of the area showed a wider, braided channel with more bare substrate (mid channel bars and the like) and exposed banks than seen in more recent photographs (Figure 2 and Figure 3). The valley was also more intensively farmed at that time, and floodplain bosque (forest) was thinner (probably with more intensively grazed understory vegetation) and less common. Countering the recovery trend, however, are floodplain development (driven by rapidly expanding populations in San Juan County and adjacent Colorado) and often-related levee construction, which have continued into the present.

Figure 2: Animas River south of Aztec, March 1950. Note wide, braided, channel and exposed substrate.

Figure 3: Animas River, October 1997. Approximately the same area depicted in Figure 2 is depicted here. Note the less braided channel and increase in vegetation along the channel and in the adjacent floodplain. At a given flow, the channel is probably narrower and deeper now than it was in the 1950's.

Temperature in the Animas River

SWQB staff recorded water temperatures greater than the water quality criterion of 23°C in the Animas River upstream of Aztec in 2002. This criterion is intended to protect a coldwater fishery use of the Animas River. Thermographs (continuous temperature recording devices) were deployed in the Animas River at Cedar Hill and in Aztec from July 14 through August 20 2003. Exceedences of the temperature criterion were sufficient for the Animas River to be added to the 2004-2006 303(d) List for temperature. The maximum temperature at Cedar Hill was just under 27°C, and the temperature typically exceeded 25°C on warm days. The maximum temperature at Aztec was 29.8°C, and the temperature typically exceeded 27°C on warm days.

During the May 7 2003 meeting, the San Juan Watershed Group prioritized water quality problems by stream segment, and arrived at a consensus that the high temperatures observed in the upper segment of the Animas River represent a low priority water quality problem mainly because the Group thought that it would be impractical to address the problem.

Comments supplied above regarding how temperature may affect nutrient problems apply to this section as well.

Acute Toxicity

Among the sampling conducted in 2002 were "acute toxicity tests", by which SWQB staff collected water and sediment samples from several sites on the San Juan and Animas Rivers and shipped them to Dallas on ice for analysis with living organisms[19]. *Cerodaphnia* (water fleas) and fathead minnows were placed in either the river water samples or in water on top of the sediment after mixing and a period of settling followed by filtration (producing "elutriate"), and their mortality was observed and compared with mortality observed with a control, non-toxic water solution. 25% of fathead minnows died in sediment elutriate from the Animas River at the Colorado state line on one of two sample dates. 100% of *Cerodaphnia* and 12.5% of fathead minnows died in elutriate from the Animas River at Farmington on one of two sample dates. Water samples from the Animas River were not found to be toxic.

A water sample from the San Juan River at Blanco killed all *Cerodaphnia*, and sediment elutriate from that site killed 65% of fathead minnows. A San Juan River water sample from below Kutz Canyon killed 100% of *Cerodaphnia*, with no sediment toxicity.

In each case, mortality was significantly greater than observed in the control solution, and suggests the presence of one or more toxins that have not been identified. These data were sufficient for SWQB to add the Animas River between Farmington and Aztec and the San Juan River upstream from the Animas River to Largo Canyon to the 2004-2006 303(d) List for "acute toxicity", but the San Juan Watershed Group is hesitant to concur because this listing is based on so few data.

More sampling is required to verify this toxicity and pinpoint the direct causes. Among the likely causes on the Animas River is ammonia, which may have been liberated from the sediment upon agitation. Significant quantities of ammonia are related to nutrient enrichment. Possibly related to toxicity in the San Juan River is illicit dumping on public or private lands, a problem widely acknowledged in the San Juan Basin. This problem was discussed during the July 11 2002 Watershed Group meeting, during which an area resident with property at the lower end of Horn Canyon described dramatic variations in color and odor following storm events (including rafts of horse manure, and unusually red runoff following one storm event) and caused, he believes, by the dumping of waste materials into small tributary drainages in the watershed of Horn Canyon. Though this problem is unlikely limited to Horn Canyon, the sample which killed 100% of *Cerodaphnia* was collected from the San Juan River a short distance downstream of Horn Canyon.

[19] The methods used are described in greater detail on the Internet at www.epa.gov/earth1r6/6wq/ecopro/watershd/monitrng/toxnet/methods.htm. The data are available at www.epa.gov/earth1r6/6wq/ecopro/watershd/monitrng/toxnet/nm.pdf.

Selenium in Gallegos Canyon

SWQB sampled Gallegos Canyon in 2002 for a suite of metals, ions, nutrients, and organic compounds. Other agencies collected similar data from 1994 through 2003 in support of the Recovery Implementation Program. Of thirty measurements, 23 exceeded of the total recoverable selenium criterion of 7.5 μg/L. Because of these selenium concentrations, New Mexico Water Quality Standards indicate that this stream does not support it's designated use as wildlife habitat, and for this reason Gallegos Canyon was added to the 2004-2006 303(d) List.

The selenium probably has a natural geologic source in the watershed of Gallegos Canyon, but agricultural runoff and seepage of irrigation water from fields in the upper watershed emerging in lower Gallegos Canyon may have elevated the concentrations.

Selenium may be present at concentrations in excess of criteria set in State water quality standards in other waters as well (Blanchard and others 1993, Thomas and others 1998).

Fish Tissue Mercury

Navajo Reservoir, Lake Farmington, and all three analyzed segments of the San Juan River are on the 2004-2006 303(d) List for fish tissue mercury. These listings are based on guidance provided by the New Mexico Department of Health, which has a periodic sampling program and develops fish consumption advisories based on observed mercury concentrations[20]. Some of these advisories are confirmed by data collected in 2001 by SWQB staff. The advisories generally state how much of specific fish species may be consumed (in meals per month, for example). Often, a size limit is given (larger fish have more mercury). Separate recommendations are given for the general population and the "sensitive population" of pregnant women, nursing mothers, women planning to become pregnant, and children under eighteen.

The San Juan River is one of only two rivers in New Mexico with fish consumption advisories. Fish consumption advisories are much more common in reservoirs and other lakes because the anaerobic environment on lake bottoms facilitates mercury uptake through the food chain. The release of water from the bottom on Navajo Reservoir into the San Juan River may be the source of much of the mercury loading into the San Juan River.

While there is no advisory for trout in any of these water bodies, there are advisories for species which people commonly consume, and for the sensitive population these advisories would likely limit fish consumption in many people were they aware of the problem. For example, from Navajo Reservoir, the sensitive population is advised to eat black bass (which also means largemouth, smallmouth, or spotted bass) only if they are shorter than thirteen inches. The general population is advised to eat black bass only if they are shorter than 17 inches, and to eat black bass 13-16 inches long with one or two meals per month at most. The general population

[20] Full fish consumption advisories are available from the Internet at http://www.nmenv.state.nm.us/swqb/Mercury.pdf.

is advised to eat channel catfish (31 to 41 inches) from the San Juan River between the Hogback and Hammond Diversion with one or two meals per month at most.

The primary sources of fish tissue mercury in the San Juan Basin are probably atmospheric deposition, and runoff from areas impacted by historic and current mining. Many other sources exist, and much of the anthropogenic mercury present in the San Juan Basin was probably emitted elsewhere, and years ago. EPA's 1997 report to Congress on mercury (USEPA 1997), an eight-volume, 2000-page document, is a useful source of information on mercury[21]. According to this report, coal-fired power plants are a major source of mercury in the atmosphere, accounting for a third of anthropogenic emissions in the United States.

[21] This document is available on the Internet at www.epa.gov/airprogm/oar/mercury.html.

5. WATER QUALITY PROTECTION AND RESTORATION APPROACHES

Sedimentation

The San Juan Watershed Group has not developed a consensus regarding whether sedimentation represents a water quality problem in the San Juan River, or regarding the relative importance of various components of the system.

Operation of Navajo Dam eliminated sediment loading from upstream of the dam, but also reduced the ability of the San Juan River to transport sediment delivered from Largo Canyon and other tributaries. SWQB concluded that the overall effect has been an accumulation of sediment beyond what would naturally occur in the reach between the Animas River and Largo Canyon. While SWQB has recognized sediment accumulation upstream of the Animas River as a water quality problem, the U.S. Fish and Wildlife Service has recognized habitat characteristics related to sediment transport dynamics as factors limiting reproduction and survival of two endangered fish species, the Colorado pikeminnow and razorback sucker, in the San Juan River downstream of the Animas (Bliesner and Lamarra 2000). The U.S. Bureau of Reclamation proposes to mitigate the second problem by implementing the flow recommendations developed under the San Juan River Basin Recovery Implementation Program (Holden 1999). These flow recommendations (or similar) have essentially been implemented since 1992, and have increased maximum flows in the San Juan in the spring (and reduced flow at other times of year, especially upstream of the Animas River) since then.

The aim of the flow recommendations is to preserve or improve critical habitat of endangered fish species downstream of the Animas River during most years. As such, in years when the Animas River produces adequate peak flow in the spring (such as 2002), or when reservoir levels are exceptionally low, the spring release from Navajo Dam may be relatively small, with the result that sediment deposited in the San Juan upstream of the Animas River since the last large release may not be flushed downstream. Despite this limitation, implementation of the flow recommendations has probably had a net positive effect on the San Juan upstream of the Animas, and more definitively downstream of the Animas, with regards to sediment.

It is important to note that this change in management of Navajo Dam, without changes to reduce loading of pollutants (other than sediment), may result in some undesirable consequences for water quality during baseflow as compared to conditions under historic dam operation (Anonymous 2002a). Although releases from Navajo Dam do not routinely drop below 500 cfs during the summer months (when some water quality problems are likely to be most evident), the effects of releases as low as 250 cfs in summer (Anonymous 2001) and winter (Salisbury 1996) have been investigated and more exceedences of water quality criteria were observed at these flows. Prior to construction of Navajo Dam, flows at Archuleta between 250 and 500 cfs were not uncommon in late summer, fall, and early winter. Pollutant loadings may be reduced to offset the effect of low baseflows, as described in greater detail below.

In addition to improving the ability of a river to *transport* a given sediment load, management changes could be instituted to *reduce* the sediment load. Opportunities to reduce sediment loading to both the San Juan and La Plata Rivers exist. Probably chief among them are improved

enforcement of the terms ("conditions of approval") of coal bed methane leases on BLM and Carson National Forest lands, revision of standard conditions of approval language to improve drainage (and reduce erosion) from well access roads[22], and development of more effective reclamation techniques for well sites, roads, and pipelines. The BLM and several oil and gas operators who in 2001 formed the San Juan Basin Public Roads Committee may address some of the problems associated with roads. The goal of this group is to bring the primary access roads up to proper road standards by about 2011 and keep them there.

Two area ranchers, Don and Jane Schreiber, have developed collaborative relationships with BLM staff and with Burlington Resources (which leases subsurface rights under the Schreibers' private property and under the BLM grazing allotment which the Schreibers lease) and are experimenting with alternative reclamation techniques at their ranch in the Largo Canyon watershed. The method they are testing utilizes confined livestock and straw to introduce organic matter and break up the surface of the ground prior to applying an appropriate seed mix.

Cattle and horses grazing on irrigated pasture, often within a few yards of the San Juan River, are common, especially between Blanco and Bloomfield. Livestock do have access to the river at specific locations, but this access is not common. More commonly, fences, thick woody vegetation, or vertical banks prevent livestock from reaching the river or trampling banks. Unstable banks are relatively common along the listed reach of the San Juan, but the sediment load moving down the San Juan River is large enough that bank erosion seems to necessarily be a minor contributor (Ron Bliesner, personal communication). However, bank erosion is a priority to individual landowners, as evidenced by efforts at protecting banks with riprap in some locations. And livestock do probably contribute to bank erosion on the San Juan in specific locations. On the La Plata River, bank erosion due to heavy livestock use is probably much more significant.

Livestock grazing in upland areas may contribute sediment via tributaries to the San Juan and La Plata Rivers. In both upland and riparian areas, specific improvements in grazing management might be warranted including complete exclusion of cattle from specific riparian areas, limiting grazing to the dormant season, providing sources of water away from the river, or more carefully tracking utilization of plants (and moving cattle when appropriate) to maintain their productivity[23]. The BLM requires or encourages several of these practices, and so the initial focus of improved grazing management may best be directed towards public lands permittees or the owners of private or other lands.

Fecal Coliform Bacteria and *E. coli*

There is currently a lack of agreement among the San Juan Watershed Group regarding which are the important sources of fecal coliforms or *E. coli* in each of the streams where they have been recognized as a problem. Several participants feel that improperly functioning septic tanks

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[22] A useful guide for designing and constructing low maintenance roads (Guenther, Oishi, and Guenther 1999) can be ordered from www.wildlandsolutions.com.

[23] A useful introduction to planned grazing (Gadzia 2003) is available free of cost from Earth Works Institute, 1413 2nd St., Ste. 4, Santa Fe, NM 87505 (or send email requests to earthworks_jan@earthlink.net).

and leach fields are likely a significant source. Others feel that more information is needed before that assumption should be accepted. The Group also generally agreed that, even if a source (*e.g*. septic tanks) is assumed to be significant, the areas contributing the most pollutant loading are unknown.

For these reasons, the Group recognized a need for more information. Initially, confirmation that high numbers of bacteria may be observed in other years or in other flow conditions than were seen in 2002 was the primary impetus of new monitoring, leading to a small sampling effort in fall 2003 conducted by USBR. This sampling seemed to confirm previous observations, leading to growing support for future sampling efforts designed to identify sources (i.e., activities or animal species) and priority areas (e.g., specific unsewered communities or groups of pastures).

The need for more information was a major driver for a short survey of *E. coli* at numerous sites on the San Juan River, and several inflows to the San Juan River, between Blanco and McGee Park conducted in September 2004. The results of this study were undoubtedly influenced by conditions specific to the dates and times of the sampling, during which cow patties and horse or mule manure were identified with certainty among recently deposited debris on the bank, and organic debris composed of sticks, juniper needles, and possibly animal manure were observed floating in the San Juan River on both days of sampling[24]. Some (but not all) tributary arroyos that were sampled, and some (but not all) inflows less clearly associated with tributary canyons (and more likely receiving bacteria loads from within the river valley), had *E. coli* levels higher than those of the San Juan River. This survey suggests at least the geographic origins of some of the bacteria loading that was occurring at that time, but even careful comparison of the data with land-use information may fail to identify the source animal species or practices which result in the loading.

Another promising area of study might be bacterial source tracking (BST) using ribotyping techniques that associate cultured bacteria with their animal host species based on differences in ribosomal RNA among bacterial strains from different host species. Such a study is underway in the middle Rio Grande valley in the vicinity of Albuquerque. That study has produced a database of characteristics of ribosomal RNA of bacteria cultured from the feces of many warm-blooded animal species to permit bacteria cultured from river samples to be associated with source animal species. This database may be suitable for use in a similar study in the San Juan Basin, reducing the time and expense of a new BST study considerably. A new study could also bracket potential source areas to identify areas with the most loading.

Projects to reduce the loading will depend on the sources that are identified, and perhaps on the mechanisms of loading.

Cheney, Walters, and Echols, Inc. (an engineering firm based in Farmington), funded by a grant from the State legislature, prepared an engineering report to evaluate treatment alternatives in the

[24] For more details, see the report available on the Internet at www.nmenv.state.nm.us/swqb/wps/San_Juan/SanJuanRiver-2004BacteriaSamplingReport.pdf.

Kirtland and Fruitland areas (Anonymous 2002d). The report[25] concludes that on-site treatment (septic tanks and leach fields) is ineffective in most of the analysis area (particularly south of Farmers Mutual Irrigation Ditch) because the infiltration capacity of the local soils is low, and because the soils are often saturated. After comparing costs and benefits of several treatment alternatives, the report recommends construction of a conventional sequencing batch reactor wastewater treatment plant.

In unsewered areas with soils that *are* conducive to on-site wastewater treatment, but where septic tanks and leach fields are failing because of lack of maintenance or poor design, or if illicit discharge of septic tank waste is determined to be a significant source of bacteria, creation of septic tank maintenance utilities (centralized management of decentralized wastewater systems) may be a practical solution[26]. Such a utility has been created in Peña Blanca, New Mexico (Rose 1999)[27], and is planned for Willard, New Mexico (Van Lenten 2003).

If it is determined that State regulations governing septic tanks are insufficient, deficiencies may be addressed with revision to the regulations. Improved regulation of septic tanks is currently a high priority of the New Mexico Environment Department, and the Department believes that revision of regulations and improved enforcement funded with recently (spring, 2004) authorized expenditures from the Corrective Action Fund will facilitate this[28].

Urban runoff may also be contributing to bacteria loading. Pet waste and feces from birds or other wildlife typically reach surface waters much faster in an urbanized environment, where impervious surfaces are common and drainage networks have been simplified, than in rural or natural portions of watersheds. Practices to reduce loading from pet waste, including education of pet owners, and practices to slow and infiltrate runoff within urban areas, may thus benefit surface water quality. Proper management of waste from horses or other livestock by homeowners in lower density subdivisions may also be worthy of encouragement.

If it is determined that livestock are significant contributors of bacteria to surface waters, then another approach to reducing loading would be to encourage improved management of grazing in riparian zones, and to manage floodplain pastures to prevent runoff of excess irrigation water or precipitation from fields that have been recently grazed. Specific improvements might include complete exclusion of cattle from specific portions of riparian areas, or limiting grazing to the dormant season, or more carefully tracking utilization of riparian plants (and moving cattle out when appropriate) to maintain their productivity[29]. As the BLM already implements or encourages several of these practices, the initial focus of improved grazing management may best be directed to private or other lands.

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[25] The report may be requested from Cheney, Walters, and Echols, Inc., 909 W. Apache, Farmington, NM 87401 (505-327-3303) or from the NMED Construction Programs Bureau, 1190 St. Francis Dr., P.O. Box 26110, Santa Fe, NM 87502 (505-827-2806).

[26] A report describing this option may be downloaded from the Internet at www.sewerless-wastewater-solutions.org/images/WWGuide.pdf.

[27] This report may be downloaded from the Internet at www.nesc.wvu.edu/nodp/pdf/PenaBlanca.pdf.

[28] For more information about this process, including a link to the draft regulations, see www.nmenv.state.nm.us/fod/LiquidWaste/reg.rewrite.html.

[29] A useful introduction to planned grazing (Gadzia 2003) is available free of cost from Earth Works Institute, 1413 2nd St., Ste. 4, Santa Fe, NM 87505 (or send email requests to earthworks_jan@earthlink.net).

In some few areas, riparian areas or arroyos are used as holding and feeding areas for livestock. In these situations, preventing animals' direct access to streams or arroyo bottoms with fencing, and providing off-channel sources of water, may significantly reduce bacteria loading.

For many of these potential sources, enhancement, protection, or creation of wetlands may help reduce the numbers of fecal coliform and *E. coli* bacteria in shallow subsurface or surface runoff before it reaches a river. The normal habitats for these bacteria are the digestive tracts of warm-blooded animals, and they tend to die off with time in non-optimal conditions.

Plant Nutrients and Dissolved Oxygen

As with fecal coliform bacteria and *E. coli*, the relative importance of the various potential sources is poorly understood at present and requires more study before efforts can be effectively directed to remedying the problem. The ongoing work of the Animas River Nutrients Workgroup may enlighten future decisions in this regard.

As with bacteria, failing septic tanks are a potential source of plant nutrients. As such, the discussion provided above regarding wastewater treatment alternatives applies to this section also.

Municipal point sources may also play a role. The City of Aztec is in the process of planning and obtaining funding for a new or substantially upgraded wastewater treatment plant that may reduce nutrient loading to the Animas River below Aztec, and similar upgrades are planned for the Durango area. Aztec and Bloomfield both are also in the process of improving sludge treatment. The City of Farmington also recently completed an upgrade increasing the capacity of their plant and improving the level of treatment.

As noted earlier, whether nutrient loading results in growth of nuisance algae depends on the resulting nutrient concentrations and on temperature and illumination of the water (which is in turn dependent upon water shading, clarity and depth). Actions that reduce water temperature, which shade the water, or which increase channel depth (at some expense to channel width) may therefore reduce algae growth. In this regard, changes in floodplain management may have benefits for water quality. Levee construction, in particular, could be relied upon less in favor of preservation or restoration of functioning floodplains, especially where permanent structures are absent. Levees tend to maintain wider, shallower channels and may inhibit establishment of large trees near the water's edge.

An alternative to levees which may be more expensive to construct, but which may require less maintenance and support a broader range of resources including water quality, is the use of engineered rock structures to protect banks from erosion and maintain deeper, narrower channels. These structures should be coupled with adjacent floodplains to accommodate high flows without increasing erosive force (Rosgen, no date)[30]. An example of this approach can be found on the property of Jim Young downstream of Aztec, where a 1900 foot reach was

[30] This paper can be downloaded from the Internet at www.wildlandhydrology.com/assets/cross-vane.pdf.

realigned with less rock than would have been required with construction of a full levee, and where a floodplain was constructed to accommodate floods (Figure 4).

A related approach is to intercept nutrients moving in shallow ground water or irrigation return flow with off-channel wetlands. These wetlands should generally lie between nutrient sources and the river, which is a gaining stream during flow conditions when nutrient problems are most likely to be noticed. The most important mechanism by which nitrogen is removed from aquatic systems by wetlands is denitrification, by which anaerobic bacteria convert nitrate to molecular, atmospheric nitrogen[31]. There isn't a mechanism as effective for removing phosphorus, although sedimentation of insoluble, inorganic forms of phosphorus may be significant in wetlands with abundant iron and aluminum (low-pH wetlands) or calcium (high-pH wetlands).

Wetlands also tend to transform inorganic nitrogen and phosphorus to less biologically available organic forms, and are able to buffer pulses of nutrients from watersheds by storing and slowly releasing them. These characteristics of wetlands reduce the likelihood of algal blooms and other undesirable changes to aquatic communities.

Comments made above regarding the potential benefits of improved livestock management apply to this section as well.

[31] Useful summaries of nitrogen and phosphorus cycling in wetlands are available at edis.ifas.ufl.edu/BODY_SS303 and edis.ifas.ufl.edu/BODY_SS302.

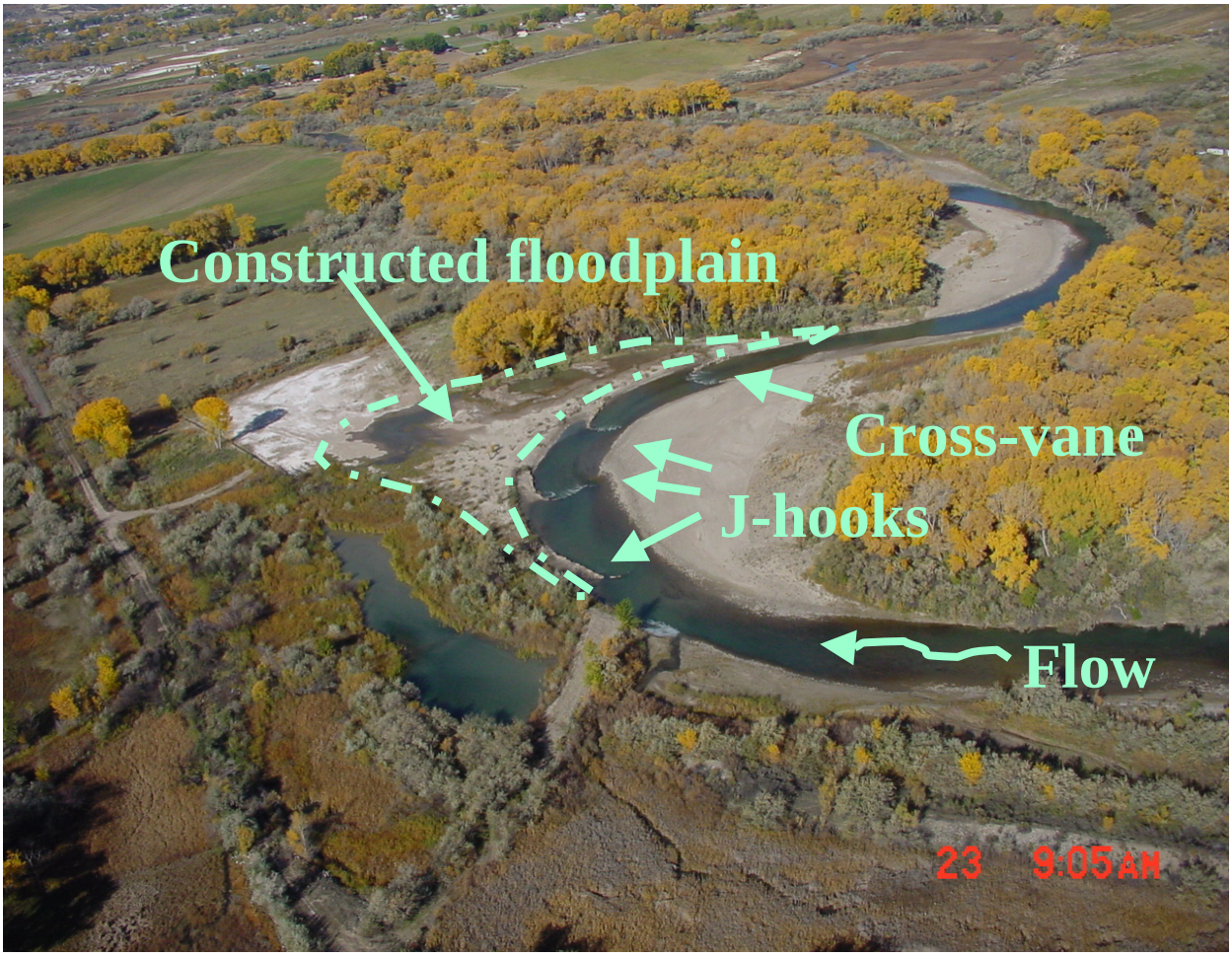

Figure 4: Bank stabilization project on the Animas River

Temperature in the Animas River

Comments supplied above regarding how temperature may affect nutrient problems, and how management choices can reduce water temperatures, apply to this section as well.

Acute Toxicity

More study would be required to identify the constituents that have actually caused mortality of fathead minnows and *Cerodaphnia* in past toxicity tests. Among the likely constituents is ammonia, which is a product of anaerobic decomposition and can become concentrated in nutrient-enriched waters or their underlying sediment. If ammonia is partly or wholly the cause of the observed toxicity, then addressing nutrient enrichment as described above may address this problem.

Selenium in Gallegos Canyon

Butler (2001) observed a 28% decrease in selenium loading to Montrose Arroyo (in the Gunnison River basin) following installation of pipes in irrigation laterals.

The Uncompahgre River Basin Selenium Phytoremediation project[32] in Colorado is nearing completion and may provide insight to agricultural production methods that may result in uptake of selenium by plants and export with agricultural products such as hay, poplar, and kenaf. As of this writing, chemical analyses of shallow groundwater, soils, and plant matter are being completed.

W.G. Wright (1994) investigated the potential of elevated concentrations of nitrate in ground water to oxidize and mobilize selenium. Utilizing ground water quality data from irrigated land underlain by Cretaceous Mancos Shale in western Colorado (investigated as part of the Department of the Interior National Irrigation Water-Quality Program), concentrations of dissolved selenium were positively correlated with dissolved nitrate plus nitrite[33]. Nitrate oxidation of selenium is most effective where high nitrate concentrations occur in ground water that flows through shale bedrock. More carefully managing timing and rates of nitrate fertilizer application may reduce nitrate concentrations in ground water.

In high priority areas, bioremediation (removal of pollutants by fostering specific microbial communities) of selenium may be practical. Such an effort to reduce selenium loading to critical wildlife habitat in the San Joaquin Valley of California was described by Oswald and others (2000) and Cantafio and others[34] (1996).

Thomas and others (1998) found that water samples from seeps and tributaries to the San Juan River draining irrigated land developed on Cretaceous soils contained about 10 times more selenium than samples from sites draining irrigated land developed on non-Cretaceous soils. This finding may help prioritize locations for implementing the practices described above.

Fish Tissue Mercury

The mercury within the tissue of fish in the San Juan Basin likely has sources within the Basin and beyond. As such, national and international policy decisions and regulation may be required to result in measurable reductions in fish tissue mercury at any one locality. Due to mercury's persistence, the amount of time required for measurable reductions may be great, as much of the mercury present in aquatic environments (and the atmosphere) today was emitted long ago.

EPA's Mercury Study Report to Congress (USEPA 1997) includes detailed descriptions of mercury control methods and associated costs.

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[32] Contact: Frederick S. Fisher, Shavano Soil Conservation District, 12756 Shavano Valley Rd., Montrose, Colorado, 81401. (970) 240-1928. ffisher@frontier.net

[33] The abstract for this article may be found on the Internet at www.usbr.gov/niwqp/Bibliography/niwqp.abs/html%20abs/Wright1.htm.

[34] Cantafio and others (1996) is available on the Internet at aem.asm.org/cgi/reprint/62/9/3298.pdf.

6. FUNDING

This section is organized by funding program, and attempts to summarize for each program the types of activities supported, who may apply, and the application procedure. A source of further information is also provided for each funding program. The programs described in this section are only a small sample of the programs that could conceivably support water quality protection or improvement in the San Juan Basin. Additional information is available from more general sources, such as EPA's Catalog of Federal Funding Sources for Watershed Protection, an online searchable database that includes links to non-federal funding sources as well[35].

Natural Resources Conservation Service Conservation Programs

The Environmental Quality Incentives Program (EQIP) is the main conservation program administered by the Natural Resources Conservation Service (NRCS)[36], with technical assistance provided by Local Working Groups. In San Juan County, the Local Working Group is the San Juan Soil and Water Conservation District. Agricultural producers (including small producers) are eligible to participate in this program. The program's main objective is to enhance agricultural production while conserving or protecting other natural resources, including water quality. A large number of activities are eligible for funding. Activities with the greatest potential for improving or protecting water quality (and identified in this Watershed Management Plan) include fencing, wetland restoration, several erosion control methods, and planning and design of projects or management systems. This is a well-funded program, and many people in all areas of New Mexico benefit from the program each year. To handle the volume of applications, NRCS has developed a detailed set of evaluation criteria. Among the criteria are whether the project will improve water quality in a stream found on the Clean Water Act 303(d) List Local NRCS or SWCD staff are generally available to help applicants, who can submit their applications at any time. The applications are evaluated and selected for funding in early spring. Matching funds or in-kind labor is required, and the percentage depends on the practices that will be implemented.

Other programs that may also be able to address water quality issues include the Wildlife Habitat Incentive Program and the Wetland Reserve Program[37].

U.S. Bureau of Reclamation

The U.S. Bureau of Reclamation (USBR) includes planning, designing, building and operating water resources projects in its mission. Another activity related to water resources is protecting

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[35] The Internet address for this resource is cfpub.epa.gov/fedfund/.

[36] Allen Maez of NRCS (505-334-3090) is the main contact for this and other NRCS programs in San Juan County. On the Internet, www.nm.nrcs.usda.gov/programs/eqip/2004eqip-signup.html provides a good starting point for learning more about EQIP.

[37] These programs are briefly described at www.nm.nrcs.usda.gov/programs/whip.html and www.nm.nrcs.usda.gov/programs/wrp.html. Interested individuals should contact the NRCS for more detailed and current information.

waterways through Section 404 of the Clean Water Act, which authorized a system for dredge and fill permits for wetlands and streams. The planning efforts for water projects, including proposed changes to Navajo Dam operations and the Animas-La Plata project, have included water quality monitoring components and related environmental studies. USBR has recently (2003) worked with the San Juan Watershed Group on a small survey of bacteria in the San Juan River, and supported the Animas River Nutrients Workgroup in 2004. The agency may play an important role in water quality monitoring in the San Juan Basin in the future.

Clean Water Act Section 319

The Clean Water Act Section 319 program in New Mexico is administered by the New Mexico Environment Department Surface Water Quality Bureau, which applies annually to EPA for funding to implement a package of projects to improve water quality where water quality standards are not met, even though applicable permitting programs are in place. As such, this program generally addresses nonpoint source pollution. SWQB normally constructs its grant application using a request for proposals for projects that may be implemented by any public or private entities. A request for proposals for on-the-ground projects is scheduled for formal release on August 30 2004, and applicants will have sixty days to prepare proposals. SWQB staff are available to assist with developing proposals[38]. The San Juan Basin streams found on the 2004-2006 303(d) List will be included in this RFP. Projects funded through this program must also be supported forty percent or more by non-federal funds or in-kind contributions of labor, equipment, or supplies. This RFP will be available on the Internet shortly after its release[39].

Projects funded under this program generally include a public outreach component, and may include planning or monitoring components, but generally emphasize work on the ground such as stream bank stabilization, livestock management improvement through fencing or other means, urban stormwater management, wetland restoration, and development of wastewater treatment alternatives. This program supported the bank stabilization project described in Section 5.

New Mexico Environment Department Construction Programs Bureau

NMED's Construction Programs Bureau[40] administers four programs that may help San Juan Basin communities manage wastewater better, thus potentially reducing bacteria or nutrient loading to the San Juan, Animas, and La Plata Rivers. The New Mexico Clean Water State Revolving Fund is a low- or no-interest loan program (3% interest or less) that can help cities, counties, water and sanitation districts, and Indian tribes develop solutions that are affordable to ratepayers. These funds may also be used for other activities that will reduce non-point source

[38] The SWQB employee assigned to the San Juan Basin for this program is Abe Franklin, who may be reached at 505-827-2793 or abraham_franklin@nmenv.state.nm.us.
[39] A link for the RFP is expected to appear at www.nmenv.state.nm.us/swqb/.
[40] More detailed information can be found on the Internet at www.nmenv.state.nm.us/cpb/cpbtop.html, or by calling Ramona Rael of the Construction Programs Bureau at 505-827-2808.

pollution loading. The Cities of Farmington and Bloomfield have utilized this program to upgrade or expand their wastewater treatment systems.

The Rural Infrastructure Revolving Loan Program is a smaller but somewhat more flexible program than the Clean Water State Revolving Fund. The Clean Water State Revolving Fund program requires that a Preliminary Engineering Report be completed prior to application, and the Rural Infrastructure Revolving Loan Program can be used to fund development of that report.

The New Mexico Special Appropriations Program is funded through State legislative appropriations for water, wastewater and other environmental infrastructure construction projects to protect public health and water quality. Municipalities, counties, special districts, Indian tribes, and water or wastewater mutual domestic associations are eligible. As of July 1 2003, the Construction Programs Bureau was managing 276 active appropriations with a combined unpaid balance over $9,300,000. The funding cycle is annual when authorized by the New Mexico Legislature and approved by the Governor, and eligible entities must apply through their legislative representation.

Congressional appropriations, in the form of EPA State and Tribal Assistance Grants (STAG) are available in a manner similar to the State appropriations. The Construction Programs Bureau administers these grants for EPA through a memorandum of understanding. Interested communities should contact their Congressional delegation.

US Fish and Wildlife Service Partners for Fish and Wildlife Program

The Fish and Wildlife Service Partners for Fish and Wildlife Program is a federally funded program intended to improve wildlife habitat on private property and other non-federal lands[41]. Because of the heavy reliance of many wildlife species on riparian and aquatic habitat, there are many opportunities to improve these habitats in ways that also meet water quality objectives. Interested individuals or organizations begin by filling out an application form that includes a general description of the project, the habitat and species it will benefit, the proposed project's location, and the anticipated costs. Applications are accepted year-round. Fish and Wildlife Service staff are available to assist with developing applications, and may be able to visit the project site and meet with the landowner before the application is prepared. There is a minimum of twenty percent cash or in-kind non-federal match required of grant recipients, and grant recipients are required to sign an agreement that specifies the terms of the grant, possibly including a promise to maintain the project for ten years or more. The terms of such an agreement may be passed on to future landowners as well.

Local Governments

The Cities of Farmington and Bloomfield, and the Town of Aztec, often cooperate in regional planning efforts and have cooperated in projects related to water supply and water treatment. Staff from all three municipalities have expressed interest in supporting a regional monitoring

[41] More detailed information is available at ifw2es.fws.gov/NewMexico/partners.html.

program relevant to their needs of providing safe drinking water, and have extended their interest to include monitoring for bacteria, as either an indicator of other contamination or as a hazard to swimmers and boaters. Their support is contingent on agreement by their City Councils, and may also depend on the availability of other funds.

The San Juan County government is well positioned to assist with water quality improvement projects in unincorporated areas. County support is most likely for projects that are within the range of activities traditionally taken on by county government, such as maintaining roads, or developing economical wastewater treatment alternatives.

The Southwestern Water Conservation District is a local government agency that (partly through smaller conservancy districts) stores, manages and allocates surface water in the San Juan and Dolores River Basins in southwestern Colorado. The Southwestern Water Conservation District has supported water quality monitoring in the Silverton area, and more recently supported the Animas River Nutrient Workgroup with small grants to pay for data analysis.

Private Property Owners

The owners of private property, especially along the San Juan, Animas, and La Plata Rivers, are among those most effected by water quality, and are often in the best position to address water quality problems. Private property owners may wish to protect or improve water quality to preserve the recreational opportunities that rivers offer, or they may have objectives such as erosion prevention or improved wastewater treatment that coincidentally can benefit water quality. Others would implement inexpensive practices to protect water quality if they were simply aware of them (such as proper disposal or use of horse manure), out of a sense of responsibility to their communities. The expense that private property owners incur, in both money and time, can directly benefit water quality, and can also be used to match other (generally federal) funding sources, if their individual efforts are part of a larger program.

7. IMPLEMENTATION SCHEDULE

A logical timeline of events that could lead to implementation of a significant number of projects identified in Section 5 follows:

Table 12: General proposed implementation schedule

Actions	**2004**	**2005**	**2006**	**2007**	**2008**
Public outreach and involvement	X	X	X	X	X
Watershed management plan development	X				
Identify water quality goals	X				
Secure funding	X	X	X		
Implement projects		X	X	X	
Determine project effectiveness				X	X
Re-evaluate water quality goals					X

The projected schedule of monitoring and assessment activities conducted by the Surface Water Quality Bureau, and actions taken by the New Mexico Water Quality Control Commission, follows on the next page. The specific timing and nature of some of these events is very approximate.

Table 13: Projected activities of SWQB, NMWQCC, and EPA related to surface water quality in the San Juan Basin, 2005-2010

Action	2005 (Quarter)				2006 (Quarter)				2007 (Quarter)				2008(Quarter)				2009 (Quarter)				2010 (Quarter)			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Draft TMDL's available for public comment	X																							
WQCC approves final TMDL's		X																						
New NPDES permits address waste load allocation portion of TMDL's			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
San Juan Basin applicants may apply for funding under Sec. 319(h) RFP			X				X																	
WQCC adopts new water quality standards			X																					
EPA approves new water quality standards						X																		
Draft 303(d) List available for public comment						X								X								X		
EPA approves 303(d) List								X								X								X
Review of water quality standards begins																		X						
SWQB conducts water quality survey																					X	X	X	X

REFERENCES

Abell, R. 1994. San Juan River Basin Water Quality and Contaminants Review. Museum of Southwestern Biology, Department of Biology, University of New Mexico, Albuqeurque, NM.

Anonymous. 2000. Animas-La Plata Project Draft Supplemental Environmental Impact Statement. Bureau of Reclamation Western Colorado Field Office, Durango, CO.

Anonymous. 2001. Summer Low Flow Test Report, San Juan River, New Mexico and Utah. Bureau of Reclamation Western Colorado Field Office, Durango, CO.

Anonymous. 2002a. Navajo Operations Environmental Impact Statement Water Quality Resource Report. Bureau of Reclamation Western Colorado Field Office, Durango, CO.

Anonymous. 2002b. San Juan River, Farmington to Navajo Dam, Riparian Vegetation and Wetted Area, July 12 2001. Bureau of Reclamation Western Colorado Field Office, Durango, CO.

Anonymous. 2002c. Draft Resource Management Plan and Environmental Impact Statement. Bureau of Land Management Farmington Field Office, Farmington, NM.

Anonymous. 2002d. Final engineering report, Kirtland Service District, San Juan County, New Mexico. Cheney, Walters, and Echols, Inc., Farmington, NM.

Blanchard, P.J., R.R. Roy, and T.F. O'Brien. 1993. Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated with Irrigation Drainage in the San Juan River Area, San Juan County, Northwestern New Mexico, 1990-91. U.S. Geological Survey Water-Resources Investigations Report 93-4065. 141 pp.

Bliesner, R., and V. Lamarra. 2000. San Juan River Basin Recovery Implementation Program Hydrology, Geomorphology, and Habitat Studies Final Report. Keller-Bliesner Engineering and Ecosystems Research Institute, Logan, UT

Butler, D.L. 2001. Effects of Piping Irrigation Laterals on Selenium and Salt Loads, Montrose Arroyo Basin, Western Colorado. U.S. Geological Survey Water-Resources Investigations Report 01-4204. 14 pp.

Byrd, D., K. Lange, and L. Beal. 2002. Water Resources Data, New Mexico, Water Year 2001. USGS Water-Data Report NM-01-1. 403 pp.

Byrd, D., K. Lange, and L. Beal. 2003. Water Resources Data, New Mexico, Water Year 2002. USGS Water-Data Report NM-01-1. 433 pp.

Cantafio, A.W., K.D. Hagen, G.E. Lewis, T.L. Bledsoe, K.M. Nunan, and J.M. Macy. 1996. Pilot-Scale Selenium Bioremediation of San Joaquin Drainage Water with *Thauera selenatis.* Applied and Environmental Microbiology. 62: 3298-3303.

Cruz, R.R., R.K. DeWees, D.E. Funderburg, R.L. Lepp, D. Ortiz, and D.A. Schaull. 1994. Water Resources Data – New Mexico Water Year 1993. USGS Water-Data Report NM-93-1. 590 pp.

Davis, D.R. 1992. Water Quality Survey of Lake Farmington in San Juan County, New Mexico, April 29-30, July 29-30, and October 22-23, 1991, pp. 179-195. *In:* Intensive Water Quality Stream Surveys and Lake Quality Assessment Surveys, 1991. NMED/SWQ-92/2 244 pp.

Gadzia, Kirk. 2003. Rangeland Health and Planned Grazing Field Guide. A joint publication of Earth Works Institute, the Quivira Coalition, and Kirk Gadzia.

Guenther, K., C. Oishi, and C. Guenther. 1999. Low Maintenance Roads for Ranch, Fire, and Utilities Access: a Practical Field Guide. Wildland Solutions, Brewster, WA.

Holden, P.B. (Ed.). 1999. Flow Recommendations for the San Juan River. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, NM.

Odell, S. 1997. Polynuclear Aromatic Hydrocarbon Study – 1996 Annual Report on Data Collection Activities Concerning Suspected Contributions of Polynuclear Aromatic Hydrocarbons by Gas and Oil Leasing on Public Lands in the San Juan Basin, New Mexico. Bureau of Land Management Farmington Field Office. 16 pp.+appendices.

Ortiz, D., K. Lange, and L. Beal. 2001. Water Resources Data, New Mexico, Water Year 2000. USGS Water-Data Report NM-00-1. 411 pp.

Oswald, W. J., N.W.T. Quinn, T.J. Lundquist, F.B. Green, M.A. Zarate, E.L. Amweg, D.L. Stuart, D.P. Weston, T. Leighton, I. Zubieta, A. Ku, G. Anderson, D. Falaschi, and S. Mountford. 2000. The Algal-Bacterial Selenium Removal Facility at the Panoche Drainage District. With Final Report and year 3 Annual Report, CALFED Bay-Delta Program. 110 pp.

Propst, D.L., S.P. Platania, D.W. Ryden, and R.L. Bliesner. 2000. San Juan River Monitoring Plan and Protocols. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, NM.

Rose, R.P. 1999. On-Site Wastewater Management in New Mexico: a Case Study of Peña Blanca Water And Sanitation District. National Environmental Services Center, Morgantown, WV.

Rosgen, D.L. No date. The Cross-Vane, W-Weir and J-Hook Vane Structures: Their Description, Design and Application for Stream Stabilization and River Restoration. Wildland Hydrology, Fort Collins, Colorado.

Salisbury, B.A. 1996. Technical assessment of the 1996 fourteen-day low flow test of the San Juan River and the probable impact on Four Corners Power Plant. Available from Arizona Public Service Company.

Simpson, Z.R., and J.D. Lusk. 1999. Environmental Contaminants in Aquatic Plants, Invertebrates, and Fishes of the San Juan River Mainstem, 1990-1996. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, NM.

Smolka, L.R. 1992. Special Water Quality Survey of the San Juan River from Bloomfield to Shiprock in San Juan County, New Mexico, May – September, 1991, pp. 87-117. *In:* Intensive Water Quality Stream Surveys and Lake Quality Assessment Surveys, 1991. NMED/SWQ-92/2 244 pp.

Smolka, L.R. 1991. Intensive Water Quality Survey of the San Juan River from Blanco to Shiprock in San Juan County, New Mexico, August 6-9, 1990, pp. 103-117. *In:* Intensive Water Quality Stream Surveys and Lake Quality Assessment Surveys, 1990. EID/SWQ-91/1 209 pp.

Smolka, L.R. 1990. Intensive Water Quality Survey of the Animas and La Plata Rivers in San Juan County, New Mexico, August 21-24, 1989, pp. 106-117. *In:* Intensive Water Quality Stream Surveys and Lake Quality Assessment Surveys, 1989. EID/SWQ-90/2 199 pp.

Smolka, L.R. 1985. Water Quality Survey of the San Juan River from Blanco to Shiprock, New Mexico, November 12-14, 1984. EID/SWQ-85/5 38 pp.

Thomas, C.L., J.D. Lusk, R.S. Bristol, R.M. Wilson, and A.R. Shineman. 1996. Physical, Chemical, and Biological Data for Detailed Study of Irrigation Drainage in the San Juan River Basin, New Mexico, 1993-94, with Supplemental Data, 1991-95. USGS Open-File Report 93-84 supp.

Thomas, C.L., R.M. Wilson, J.D. Lusk, R.S. Bristol, and A.R. Shineman. 1998. Detailed study of selenium and selected constituents in water, bottom sediment, soil, and biota associated with irrigation drainage in the San Juan River Area, New Mexico, 1993-95. USGS Water-Resources Investigations Report 98-4213.

Thorne, C.R. 1993. Water Quality Data from the San Juan and Chaco Rivers and Selected Alluvial Aquifers, San Juan County, New Mexico. USGS Open-File Report 93-84. 37 pp.

United States Environmental Protection Agency. 1997. Mercury Study Report to Congress. EPA-452/R-97-003

Van Lenten, C. 2003. Case Study: Onsite Wastewater Management in Willard, New Mexico. National Environmental Services Center, Morgantown, WV.

Wirth, D. 1999. Polynuclear Aromatic Hydrocarbon Study – Annual Report on Data Collection Activities for 1997 and 1998 Concerning Suspected Contributions of Polynuclear Aromatic Hydrocarbons by Oil and Gas Leasing on Public Lands in the San Juan Basin, New Mexico. Bureau of Land Management Farmington Field Office. 17 pp.+appendices.

Wirth, D. 2001. Polynuclear Aromatic Hydrocarbon Study – Annual Report on Data Collection Activities for 2000 Concerning Suspected Contributions of Polynuclear Aromatic Hydrocarbons by Oil and Gas Leasing on Public Lands in the San Juan Basin, New Mexico. Bureau of Land Management Farmington Field Office. 13 pp.+appendices.

Wirth, D. 2002. Polynuclear Aromatic Hydrocarbon Study – Annual Report on Data Collection Activities for 2001 Concerning Suspected Contributions of Polynuclear Aromatic Hydrocarbons by Oil and Gas Leasing on Public Lands in the San Juan Basin, New Mexico. Bureau of Land Management Farmington Field Office. 13 pp.+appendices.

Wright, W.G. 1994. Oxidation and mobilization of selenium by nitrate - a preliminary evaluation, (abs.) in Marston, R.A. and Hasfurther, V.R., eds., Effects of human-induced changes on hydrologic systems, Am. Water Resources Assoc., Proceedings of the 1994 Summer Symposium, Jackson, Wyoming, June 26-29, 1994, p. 1070.

ACRONYMS

ARSG – Animas River Stakeholders Group
BIA – Bureau of Indian Affairs
BLM – Bureau of Land Management
BST – Bacterial source tracking
cfs – Cubic feet per second
CSI – Compliance sampling inspection
CWA – Clean Water Act
HUC – Hydrologic Unit Code
ISC – Interstate Stream Commission
MTBE – Methyl tertiary butyl ether
NIIP – Navajo Indian Irrigation Project
NPDES – National Pollutant Discharge Elimination System
NPS – National Park Service
NTU – Nephelometric turbidity units
OMI – Operations Management International
PAH – Polycyclic Aromatic Hydrocarbon
RIP – Recovery Implementation Program, short for SJRBRIP
SWQB – Surface Water Quality Bureau of the New Mexico Environment Department
SJRBRIP – San Juan River Basin Recovery Implementation Program
SJWC – San Juan Water Commission
TMDL – Total Maximum Daily Load
USBR – United States Bureau of Reclamation
USFS – United States Forest Service
USFWS – United States Fish and Wildlife Service
USGS – United States Geological Survey
USDA – United States Department of Agriculture
WQCC – Water Quality Control Commission
WWTP – Wastewater treatment plant