Section 3: Watershed Management and Improvements

Watershed Management

The foregoing section of this plan identifies sub-watersheds at highest risk for four categories of pollutants: metals, sediment, organics, and selenium. This section discusses management measures that can be used to address these problems. These recommendations are subject to revision by land use decision makers and stakeholders, and may need to be revised based on new data as they become available.

It is understood that the application of any management activities will require site-specific design and may require licensed engineering design. The recommendations in this section are general in nature and are presented to help land use decision makers and watershed stakeholders conceptualize how best to address watershed management.

Management in Impaired or not attaining Watersheds

When a surface water is assessed as impaired or not attaining (see discussion in Section 1), ADEQ implements a series of strategies that should eventually result in pollutant load reductions in the watershed. ADEQ recognizes that improvements in water quality do not just happen. They take hard work, cooperation, and frequently money to fund water quality improvement projects. To properly expend limited resources, concerned stakeholders must become knowledgeable about sources of the pollutants causing water quality impairments and the best methods for reducing pollutant loadings. Both regulatory and non-regulatory ways to lessen pollutant loading must be considered.

For each impaired or not attaining watershed, ADEQ tries to determine the best strategies for educating the target audiences about the pollutant of concern and implementing projects that would restore water quality. Identifying the best education and water quality improvement projects requires planning, coordination, and cooperation. Once an impairment is identified, one or more of the following occurs:

• Total Maximum Daily Load (TMDL) and a TMDL Improvement Plan (TIP)
• Watershed Improvement Plan
• Best Management Practices (BMP) at critical sites across a watershed
• Stakeholder teams and ADEQ program teams are created to identify regulatory and non-regulatory strategies that could reduce pollutant loading

TMDLs and TIPs

A Total Maximum Daily Load is the maximum amount (load) of a water quality parameter which can be carried by a surface water on a daily basis, without causing an exceedance of surface water quality standards. A TMDL must be prepared for each surface water listed as impaired or not attaining unless other actions are being taken that will result in the surface water meeting standards.
A TMDL is the sum of the load allocations (LAs) plus the sum of the wasteload allocations (WLAs) plus a margin of safety (MOS):

\[
TMDL = \Sigma LA + \Sigma WLA + MOS
\]

Load allocations include nonpoint source pollutant contributions, like loads from runoff from fields, streets, rangeland, or forest land. Natural background is included in the load allocation for nonpoint sources. Wasteload allocations include point source contributions, like the loads from sewage treatment plant discharges and mine adit discharges. Load allocations and wasteload allocations are based on historic and recent water quality measurements and other environmental information. Once a TMDL is calculated, necessary load reductions are determined by comparing the TMDL to the total measured or modeled load on a source-by-source basis.

A wasteload allocation would be developed for each source category identified (e.g., septic systems, grazing, urban runoff). Sampling data is also used to identify critical conditions when exceedances tend to occur. Critical conditions may be climactic (summer, winter, monsoons), hydrologic (high flows, low flows), or event-based (discharges, spills). These conditions must be considered when identifying strategies to reduce loading and when doing effectiveness monitoring.

TMDLs are calculated by ADEQ technical staff or ADEQ contractors; however, decisions about how to implement TMDLs must be made by local watershed stakeholders (the affected parties). After the TMDL is developed, ADEQ works with watershed partners to develop TMDL Implementation Plans to identify priority projects that must be implemented so that surface water standards can be met.

A TMDL Improvement Plan (TIP) indicates the improvements and strategies that need to be implemented, along with schedules, milestones, funding commitments, education needs, and effectiveness monitoring needed. It is a guidebook for bringing the impaired or not attaining surface water back into compliance with water quality standards.

TMDL Improvement Plans are a required component of developing the TMDL and are often incorporated into the document. The TIP may be the best way to direct mitigation efforts, especially if the pollutant is toxic or private property concerns rule out citizen surveys and sampling (e.g., metals and acid mine waste). TIP development may all the planning needed if the TMDL identified distinct pollutant sources that can be remediated or when adjustments in permitted discharges can resolve the problem.

Watershed Improvement Plans

ADEQ has recently initiated a Nonpoint Source grant for locally-led development of Watershed Improvement Plans (WIPs). The WIP contains the same components as a TIP -- strategies, schedules, milestones, funding commitments, education needs, and effectiveness monitoring plans. The difference is in the level of citizen involvement in developing the plan. A Watershed Improvement Council, with broad representation of
groups and individuals who might be affected by the plan (stakeholders), is developed to oversee the plan development. Volunteer citizens are recruited to survey and do further sampling in the watershed. The plan Watershed Improvement Council also identifies the priority water quality improvement projects and education needs for the watershed. The WIP developed by the community will direct the use of resources available to reduce pollutant loading.

Development of a WIP is preferable when pollutant loading from many types of sources spread out across the watershed, and when long-term voluntary efforts will be required to mitigate the loading. In such cases, the watershed community must be empowered to identify sources of the pollutants and actions that need to be taken, and then develop a Watershed Improvement Plan (WIP) to focus resources. Plan implementation is more likely when watershed stakeholders identify strategies, remediation, and education efforts for the watershed, rather than outside state government entities. Improvement projects are more likely to be maintained when the community has been involved in its development.

Such locally-led planning efforts must be closely integrated with efforts to develop and implement other types of plans and TMDLs. If successful, the WIP may shorten the time needed to develop the TMDL or eliminate the need for doing one.

BMP Implementation Across a Watershed

Sometimes additional formal planning efforts are not needed. ADEQ has recently developed another Nonpoint Source Grant to implement Best Management Practices across a watershed.

This approach is appropriate when:

- The impaired or not attaining watershed has uniform land uses
- Applicable BMPs have been identified and have been shown to be effective
- Land owners want to implement the BMPs
- Criteria can be established for determining where BMPs will be implemented and how they will be designed for maximum effectiveness

Due to the complexity associated with accurately identifying all of the relevant pollutant sources, and having all target land owners involved, these grants are usually implemented at 10-digit HUC scale or smaller.

Stakeholder Teams and ADEQ Program Teams

It will take time to address all stream reaches and lakes listed as impaired or not meeting designated uses in Arizona – more than 100 are currently listed. Therefore, ADEQ sometimes uses something as simple as a team to develop and implement regulatory and non-regulatory strategies to mitigate impairment. This can be effective in watersheds where land is primarily owned.
by a state or federal agency with a commitment to eliminate the water quality impairment. It could also be effective when permit compliance issues will need to be resolved to mitigate pollutant loading.

Site Management on New Development

Control the quantity and quality of water run-off from new development sites. The primary sources for future development in the San Juan Watershed include development of retirement communities and rural subdivisions, growth of extractive industries and power generation, and increased tourism.

ADEQ requires Aquifer Protection Permitting and the issuance of Stormwater Management Plans for active mine sites, and it is assumed that ongoing nonpoint pollutants are originating from abandoned mine sites. It is important to promote the application of nonpoint source management measures on all new development sites through cooperation with local government, developers and private land owners.

Monitoring and Enforcement Activities:

- Continue and expand water quality monitoring programs in the watershed to measure the effectiveness of management practices on protecting and restoring the waters of the San Juan Watershed.
- Promote septic tank inspections and certification of septic systems by local government entities.
- Promote construction site inspection and enforcement action for new development.

Water Quality Improvement and Restoration Projects:

- Promote efforts to protect and restore the natural functions and characteristics of impaired or not attaining water bodies. Potential projects are discussed below.
- Integrate adaptive management methods and activities across the watershed to address existing and future problems.

Education:

- Develop programs to increase the awareness and participation of citizens, developers and local decision makers on land use activities that generate nonpoint source pollutants and encourage watershed management efforts. Education programs are discussed below.

Strategy for addressing existing impairments: Metals

A TMDL (Total Maximum Daily Load) is the maximum amount of a water quality parameter that can be carried by a surface water body, on a daily basis, without causing surface water quality standards to be exceeded (http://www.azdeq.gov/environ/water/assessment/tmdl.html). The Arizona Department of Environmental Quality (ADEQ) TMDL Program is designed to help an impaired or not attaining stream
or lake meet its water quality standards and support its designated uses.

ADEQ currently has no TMDL projects for metals in the San Juan Watershed.

Potential Sources

The primary nonpoint sources of anthropogenic metals in the San Juan Watershed are abandoned or inactive mines, although naturally occurring metals originating from local highly mineralized soils may contribute to elevated background concentrations in streams and lakes. Portions of the San Juan Watershed have a history of mining, with many abandoned and several active mines found across the watershed. The principal ores are uranium and vanadium (Figure 2-2). In most cases the original owner or responsible party for an abandoned mine is unknown and the responsibility for the orphaned mine falls to the current landowner.

Abandoned mines in the San Juan Watershed in Arizona occur on the lands of the Navajo Nation. Surface runoff and erosion from mine waste are generally the principal sources of nonpoint contamination for metals. Subsurface drainage from mine waste can also be a concern.

Potential BMPs or other management action

The recommended actions include the following:

- Inventory of existing abandoned mines;
- Revegetation of disturbed mined lands;
- Erosion control;
- Runoff and sediment capture;
- Tailings and mine waste removal or containment; and
- Education.

Load reduction potential, maintenance, cost and estimated life of revegetation and erosion control treatments for addressing metals from abandoned mines are given in Table 3-1.
### Table 3-1. Proposed Treatments for Addressing Metals from Abandoned Mines.

<table>
<thead>
<tr>
<th>Action</th>
<th>Load Reduction Potential</th>
<th>Estimated Time Load Reduction</th>
<th>Expected Maintenance</th>
<th>Expected Cost</th>
<th>Estimated Life of Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revegetation</td>
<td>Medium</td>
<td>&lt; 2 years</td>
<td>Low</td>
<td>Low-Medium</td>
<td>Long</td>
</tr>
<tr>
<td>Erosion Control Fabric</td>
<td>High</td>
<td>Immediate</td>
<td>Low</td>
<td>Low-Medium</td>
<td>Short</td>
</tr>
<tr>
<td>Plant Mulch</td>
<td>Low</td>
<td>Immediate</td>
<td>Low</td>
<td>Low</td>
<td>Short</td>
</tr>
<tr>
<td>Rock Mulch</td>
<td>High</td>
<td>Immediate</td>
<td>Medium</td>
<td>Low-High</td>
<td>Long</td>
</tr>
<tr>
<td>Toe Drains</td>
<td>High</td>
<td>Immediate</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Detention Basin</td>
<td>High</td>
<td>Immediate</td>
<td>High</td>
<td>High</td>
<td>Medium-Long</td>
</tr>
<tr>
<td>Silt Fence</td>
<td>Medium</td>
<td>Immediate</td>
<td>Medium</td>
<td>Low</td>
<td>Short-Medium</td>
</tr>
<tr>
<td>Straw Roll/bale</td>
<td>Medium</td>
<td>Immediate</td>
<td>High</td>
<td>Low</td>
<td>Short</td>
</tr>
<tr>
<td>Removal</td>
<td>High</td>
<td>Immediate</td>
<td>Low</td>
<td>High</td>
<td>Long</td>
</tr>
</tbody>
</table>

**NOTE:** The actual cost, load reduction, or life expectancy of any treatment is dependent on site specific conditions. The terms used in this table express relative differences between treatments to assist users in evaluating potential alternatives. Only after a site-specific evaluation can these factors be quantified more rigorously.

### Inventory of Existing Abandoned Mines

All existing abandoned mines are not equal sources for elevated concentrations of metals. One of the difficulties in developing this assessment is the lack of thorough and centralized data on abandoned mine sites. Some of the mapped abandoned mine sites are prospector claims with limited land disturbance, while others are remote and disconnected from natural drainage features and represent a low risk pollutant source.

At sites where water and oxygen are in contact with waste rock containing sulfates, sulfuric acid is formed. As the water becomes more acidic, metals are leached from the soils and rock, generating toxic concentrations of heavy metals in the water. Acid rock drainage (also known as acid mine drainage) can be a significant water quality concern.

Management of this important source of watershed impairment begins with compiling available information from the responsible agencies. This information can be used to conduct an onsite inventory to clarify the degree of risk the site exhibits towards discharging elevated concentrations of metals to a water body.

Risk factors to be assessed include: area and volume of mine waste; metal species present and toxicity; site drainage features and metal transport characteristics (air dispersion, sediment transport, acid mine drainage, etc.); distance to a water body; and evidence of active site erosion.

Abandoned mine sites can then be ranked and prioritized for site management and restoration.

**Revegetation**

Revegetation of the mine site is the only long-term, low maintenance restoration alternative in the absence of funding to install engineered site containment and
capping. In semi-arid environments, revegetation of a disturbed site is relatively difficult even under optimal conditions. The amount of effort required to revegetate an abandoned mine site depends on the chemical composition of the mine waste, which may be too toxic to sustain growth.

![Figure 3-1: Reclaimed Mine Site](http://www.osmre.gov/awardwy.htm)

The addition of soil amendments, buffering agents, or capping with top soil to sustain vegetation often approaches the costs associated with engineered capping. If acid mine drainage is a significant concern, intercepting and managing the acidic water may necessitate extensive site drainage control systems and water treatment, a significant increase in cost and requiring on-going site operation and maintenance.

**Erosion Control**

If revegetation of the mine site is impractical, site drainage and erosion control treatments are alternatives. Erosion control actions can also be applied in combination with revegetation to control erosion as the vegetation cover is established. Erosion control fabric and plant mulch are two short-term treatments that are usually applied in combination with revegetation.

Rock mulch (rock riprap) is a long-term treatment, but can be costly and impractical on an isolated site. Rock mulch can be an inexpensive acid buffering treatment if carbonate rocks (limestone) are locally available. As the acidic mine drainage comes in contact with the rock mulch, the water loses its acidity, and dissolved metals precipitate out of the water column. A disadvantage of erosion control treatments is that they do not assist in dewatering a site and may have little impact on subsurface acidic leaching.

**Runoff and Sediment Capture**

The capture and containment of site runoff and sediment, and the prevention of waste rock and tailings from coming into contact with a water body are other management approaches. Short-term treatments include installing straw roll/bale or silt fence barriers at the toe of the source area to capture sediment.

Long-term treatments include trenching the toe of the source area to capture the runoff and sediment. If the source area is large, the construction of a detention basin may be warranted.

Disadvantages of runoff and sediment capture and containment treatments are that they may concentrate the contaminated material, especially if dissolved metals are concentrated by evaporation in detention ponds.
Structural failure can lead to downstream transport of pollutants. The detention of site runoff can also escalate subsurface drainage problems by ponding water.

Load reduction potential, maintenance, cost and estimated life of runoff and sediment control treatments such as toe drains, basins, and silt fences are found in Table 3-2.

Table 3-2. Proposed Treatments for Addressing Erosion and Sedimentation.

<table>
<thead>
<tr>
<th>Action</th>
<th>Load Reduction Potential</th>
<th>Estimated Time to Load Reduction</th>
<th>Expected Maintenance</th>
<th>Expected Cost</th>
<th>Estimated Life of Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazing Mgt.</td>
<td>Medium</td>
<td>&lt; 2 years</td>
<td>Low</td>
<td>Low</td>
<td>Long</td>
</tr>
<tr>
<td>Filter Strips</td>
<td>High</td>
<td>&lt; 2 years</td>
<td>Low</td>
<td>Low</td>
<td>Long</td>
</tr>
<tr>
<td>Fencing</td>
<td>Low</td>
<td>Immediate</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Watering Facility</td>
<td>Medium</td>
<td>Immediate</td>
<td>Low</td>
<td>Low-Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Rock Riprap</td>
<td>High</td>
<td>Immediate</td>
<td>Medium</td>
<td>Medium-High</td>
<td>Long</td>
</tr>
<tr>
<td>Erosion Control Fabric</td>
<td>High</td>
<td>Immediate</td>
<td>Low</td>
<td>Low-Medium</td>
<td>Short</td>
</tr>
<tr>
<td>Toe Rock</td>
<td>High</td>
<td>Immediate</td>
<td>Low</td>
<td>Medium</td>
<td>Long</td>
</tr>
<tr>
<td>Water Bars</td>
<td>Medium</td>
<td>Immediate</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Road Surface</td>
<td>High</td>
<td>Immediate</td>
<td>Medium</td>
<td>Medium</td>
<td>Long</td>
</tr>
</tbody>
</table>

Note: The actual cost, load reduction, or life expectancy of any treatment is dependant on site specific conditions. Low costs could range from nominal to $10,000, medium costs could range between $5,000 and $50,000, and high costs could be anything greater than $25,000. The terms used in this table express relative differences between treatments to assist users in evaluating potential alternatives. Only after a site-specific evaluation can these factors be quantified more rigorously.

Removal

The mine waste/tailing material can be excavated and removed for pollution control. This treatment is very expensive and infeasible for some sites due to lack of accessibility.

Education/Training Needs

Land use decision makers and stakeholders need to be educated on the problems associated with abandoned mines and the available treatments to mitigate the problems. In addition, abandoned mine sites are health and safety concerns and the public should be warned about entering open shafts or traversing unstable slopes. Due to the financial liability associated with site restoration, legal and regulatory constraints must also be addressed.

The target audiences for education programs are private land owners, watershed groups, local officials and land management agencies (U.S. Forest Service,
Bureau of Land Management, and Tribal entities).

Map 1.4 and Table 1.2 shows land ownership across the San Juan subwatersheds. This table provides a basis from which to identify stakeholders pertinent to each subwatershed area. Subwatershed areas prioritized for educational outreach to address metals include Cottonwood Wash, Trading Post Wash-Chinle Wash, Oljeto Wash, Lime Creek-Lower San Juan River, and Copper Canyon-Lower San Juan River.

Strategy for Addressing existing impairments: Sediment

ADEQ currently has no TMDL projects for sediment in the San Juan Watershed.

Potential Sources

Erosion and sedimentation are major environment problems in the western United States, including the San Juan Watershed. In semiarid regions, the primary source of sediment is from channel scour. Excessive channel scour and down-cutting can lead to deterioration of the condition and extent of riparian ecosystems. Increases in channel scour are caused by increased surface runoff produced by changing watershed conditions. Restoration of impaired channel riparian areas can also mitigate erosion damage.

The primary land uses in the San Juan Watershed that can contribute to erosion are livestock grazing and mining. Development and road building which also contribute to erosion, are increasing in some portions of the watershed. Impervious land surfaces accelerate surface runoff, increase flow velocity, and exacerbates channel scour. Dirt roads can be an important source of sediment as well.

Potential BMPs or Other Management Action

The recommended sediment management actions are:

- Grazing Management
- Filter Strips
- Fencing
- Watering Facilities
- Rock Riprap
- Erosion Control Fabrics
- Toe Rock
- Water Bars
- Erosion Control on Dirt Roads
- Education
Grazing Management

Livestock grazing is currently a major land use in the San Juan Watershed. Implementing grazing management practices to improve or maintain the health and vigor of plant communities will lead to reductions in surface runoff and erosion. Sustainable livestock grazing can be achieved in all plant communities by managing the duration, frequency and intensity of grazing.

Management may include exclusion of land such as riparian areas from grazing, seasonal rotation, rest or some combination of these options. Proper grazing land management provides for a healthy riparian plant community that stabilizes stream banks, creates habitat and slows flood velocities.

Filter Strips

A filter strip along a stream, lake or other waterbody will retard the movement of sediment, and may remove pollutants from runoff before the material enters the body of water. Filter strips will protect channel and riparian systems from livestock grazing and trampling. Fencing the filter strip is usually required when livestock are present. Filter strips and fencing can be used to protect other sensitive ecological resources.

Fencing

Restricting access to riparian corridors by fencing will allow for the reestablishment of riparian vegetation. Straw bale fencing slows runoff and traps sediment from sheet flow or channelized flow in areas of soil disturbance.

Watering Facilities

Alternative watering facilities, such as a tank, trough, or other watertight container at a location removed from the waterbody, can provide animal access to water, protect and enhance vegetative cover, provide erosion control through better management of grazing stock and wildlife, and protect streams, ponds and water supplies from biological contamination. Providing alternative water sources is usually required when creating filter strips and fencing.
Rock Riprap

Large diameter rock riprap reduces erosion when installed along stream channels and in areas subject to head cutting. Regrading may be necessary before placing the rocks, boulders or coarse stones, and best management practices should be applied to reduce erosion during regrading.

Erosion Control Fabric:

Geotextile filter fabrics reduce the potential for soil erosion as well as weed growth and are often installed beneath rock riprap.

Figure 3-5: Rock Riprap and Jute Matting
Erosion Control along a stream.
(Photo: Lainie Levick)

Toe Rock

Placement of rock and riprap along the toe of soil slopes reduces erosion and increases slope stability.

Water Bars

A water bar is a shallow trench with mounding along the down-slope edge that intercepts and redirects runoff water in areas of soil disturbance. This erosion control method is most frequently used at tailings piles or on dirt roads.

Erosion Control on Dirt Roads

In collaboration with responsible parties, implement runoff and erosion control treatments on dirt roads and other disturbed areas. Dirt roads can contribute significant quantities of runoff and sediment if not properly constructed and managed. Water bars and surfacing are potential treatments. When a road is adjacent to a stream, it may be necessary to use engineered road stabilization treatments.

The stabilization of roads and embankments reduces sediment input from erosion and protects the related infrastructure. Traditional stabilization relied on expensive rock (riprap) treatments. Other options to stabilize banks include the use of erosion control fabric, toe rock and revegetation.

Figure 3-6: Bank Stabilization and Erosion Control along a highway
(Photo: Lainie Levick)
Channel and Riparian Restoration

Restoration or reconstruction of a stream reach is used when the stream reach has approached or crossed a threshold of stability from which natural recovery may take too long or be unachievable. This practice significantly reduces sediment input to a system and will promote the riparian recovery process. Channel and riparian restoration will be discussed in more detail below.

Education/Training Needs

The development of education programs will help address the impact of livestock grazing and promote the implementation of erosion control treatments. Education programs should address stormwater management from land development and target citizen groups, developers and watershed partnerships.

Based on the sediment and erosion classification completed in Section 6, subwatershed areas prioritized for educational outreach to address erosion control include Nazlini Wash and Recapture Creek.

Strategy for Addressing Existing Impairments: Organics/Nutrients

Currently there are no TMDL projects for nutrients and organics in the San Juan Watershed.

Potential Sources

At locations within the San Juan Watershed, water quality problems associated with the introduction of animal waste occur. The two primary sources of animal waste in the watershed are livestock grazing in riparian areas and failing septic systems.

According to ADEQ, recent investigations have shown that nutrients and E. coli bacteria are primarily being contributed by inadequate septic systems, livestock, irrigated crop production, and human impacts in recreational areas due to inadequate toilets and trash, including animals attracted to the garbage left behind or feeding geese at urban lakes. ADEQ has learned that community-wide or watershed-wide plans and project implementation are needed to address such contributions. Replacing a dozen scattered septic systems will have only short term reductions in areas where 500 systems are inadequately sized and located adjacent to a stream. Trash clean-up campaigns have only short-term impacts if the reasons why the trash is being left have not been addressed (http://www.azdeq.gov/environ/water/watershed/download/nonpoint.pdf).

Potential BMPs or Other Management Action

The recommended actions for management of organics are:

- Filter Strips
- Fencing
- Watering Facilities
- Septic System Repair
- Education
Filter Strips

Creating a filter strip along a water body will reduce and may remove pollutants from runoff before the material enters a body of water. Filter strips have been found to be very effective in removing animal waste due to livestock grazing, allowing the organics to bio-attenuate (i.e. be used by the plants), and degrade. Fencing the filter strip and providing an alternative watering source are usually required when dealing with livestock.

Fencing

Restricting access to riparian corridors by fencing will allow for the reestablishment of riparian vegetation. Straw bale or silt fencing slows runoff and traps organics from sheet flow or channelized flow in areas of soil disturbance.

Watering Facilities

Alternative watering facilities, such as a tank, trough, or other watertight container at a location removed from the waterbody, can provide animal access to water and protect streams, ponds and water supplies from biological contamination by grazing cattle. Providing alternative water sources is usually required when creating filter strips.

Septic System Repair

One of the difficulties in assessing the impact of failing septic systems to streams is the lack of thorough and centralized data on septic systems. Although it can be assumed that residential development in areas not served by sanitary sewers will rely on private on-site septic systems, the condition of the systems are usually unknown until failure is obvious to the homeowner.

Table 3-3. Proposed Treatments for Addressing Organics and Nutrients

<table>
<thead>
<tr>
<th>Action</th>
<th>Load Reduction Potential</th>
<th>Estimated Time to Load Reduction</th>
<th>Expected Maintenance</th>
<th>Expected Cost</th>
<th>Estimated Life of Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter Strips</td>
<td>High</td>
<td>&lt; 2 years</td>
<td>Low</td>
<td>Low</td>
<td>Long</td>
</tr>
<tr>
<td>Fencing</td>
<td>Low</td>
<td>Immediate</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Watering Facility</td>
<td>Medium</td>
<td>Immediate</td>
<td>Low</td>
<td>Low-Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Septic System Repair</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Note: The actual cost, load reduction, or life expectancy of any treatment is dependent on site specific conditions. Low costs could range from nominal to $10,000, medium costs could range between $5,000 and $20,000, and high costs could be anything greater than $15,000. The terms used in this table express relative differences between treatments to assist users in evaluating potential alternatives. Only after a site-specific evaluation can these factors be quantified more rigorously.
Currently, the construction of new septic systems requires a permit from ADEQ in the State of Arizona (some exemptions apply). In addition, ADEQ requires that the septic system be inspected when a property is sold if it was originally approved for use on or after Jan. 1, 2001, by ADEQ or a delegated county agency. This is to help selling and buying property owners understand the physical and operational condition of the septic system serving the home or business. More information is available at the ADEQ website (http://www.azdeq.gov/environ/water/permits/wastewater.html). Although not required by ADEQ, older septic systems should be inspected when purchasing a home with an existing system.

At a minimum, conduct an inventory of locations where private septic systems occur to clarify the degree of risk a stream reach may exhibit due to failure of these systems. Risk factors can be assessed with GIS mapping tools, such as proximity to a waterbody, soil type, depth to the water table, and density of development. Septic system sites can then be ranked and prioritized for further evaluation.

**Education/Training Needs**

Develop educational programs that explain the sources of organics, address the impacts of livestock grazing, and promote the implementation of filter strips, fencing and alternative watering facilities. In addition, the programs should promote residential septic system maintenance, septic tank inspections and certification of septic systems by local municipalities or government entities.

Based on the results of the organics classification and ranking in Section 2, subwatershed areas that are prioritized for educational outreach to address organics include Headwaters La Plata River, McDermott Arroyo-La Plata River, Barker Arroyo-La Plata River, Shumway Arroyo, Salt Creek, Salt Creek-San Juan River, Salt Creek Wash-San Juan River, Capatain Tom Wash, Dead Man’s Wash-Chaco River, and Recapture Creek.

**Strategy for Addressing Existing Impairments: Selenium**

ADEQ currently has no TMDL projects for selenium in the San Juan Watershed.

**Potential Sources**

Selenium occurs naturally in the environment; however, it can enter groundwater or surface water from hazardous waste-sites or irrigated farmland.

**Potential BMPs or Other Management Action**

The recommended action for the management of selenium is to avoid flood irrigation of croplands, and install a mechanized irrigation system to reduce evaporation. Mechanized irrigation systems include center pivot, linear move, gated pipe, wheel line or drip irrigation. Based on a 1998 study (Hoffman and Willett, 1998) costs range from a low of $340 per acre for the PVC gated pipe to a
high of $1,095 per acre for the linear move. The center pivot cost per acre is $550, and wheel line is $805 per acre.

**Education/Training Needs**

Develop educational programs that explain the sources of selenium, and illustrate the various alternative irrigation systems.

Agriculture represents an important land use in the San Juan Watershed. Based on the results of the selenium classification and ranking in Section 2, the subwatershed areas that are prioritized for educational outreach to address selenium are Ojo Amarillo Canyon-San Juan River, Recapture Creek, Cottonwood Wash, Trading Post Wash-Chinle Wash, Oljeto Wash, and Copper Canyon-Lower San Juan River.

**Strategy for channel and riparian protection and restoration**

Riparian areas are one of the most critical resources in the San Juan Watershed. Healthy riparian areas stabilize stream banks, decrease channel erosion and sedimentation, remove pollutants from surface runoff, create wildlife habitat, slow flood velocities, promote aquifer recharge, and provide recreational opportunities.

As ground water resources are tapped for water supply, many riparian areas across the watershed are in danger of being dewatered as the water table drops below the base of the stream channel. In cooperation with responsible management agencies, riparian protection and restoration efforts should be implemented across the watershed.

**Education/Training Needs**

The education effort can be supported by the Arizona Nonpoint Education of Municipal Officials (NEMO) program. Arizona NEMO works through the University of Arizona Cooperative Extension Service, in partnership with the Arizona Department of Environmental Quality (ADEQ) Water Quality Division, and the Water Resources Research Center. The goal of Arizona NEMO is to educate land use decision-makers to take voluntary actions that will mitigate nonpoint source pollution and protect our natural resources.

Education programs need to be developed for land use decision makers and stakeholders that will address the various sources of water quality degradation and present management options. The key sources of concern for educational programs are:

- **Abandoned Mines** (control of runoff and sediment)
- **Grazing Management** (erosion control treatments and riparian area protection)
- **Streamside Protection** (filter strips and alternative watering facilities)
- **Riparian Management** (bank stabilization, filter strips and livestock fencing)
- **Septic Systems** (residential septic system maintenance, licensing and inspection programs)
San Juan Watershed Management and Improvements

- Stormwater Management (control of stormwater runoff from urbanized and developing areas)
- Water Conservation (for private residents and to prevent dewatering of natural stream flow and riparian areas)

Local Watershed Planning

The first component of the watershed-based planning process is to summarize all readily available natural resource information and other data for a given watershed. As seen in Section 1 of this document, these data are at a broad-based, large watershed scale and include information on water quality, land use and cover, natural resources and wildlife habitat.

It is anticipated that stakeholder groups will develop their own planning documents. The stakeholder group watershed-based plans may cover a subwatershed within the San Juan Watershed or include the entire watershed area.

In addition, stakeholder group local watershed-based plans should incorporate local knowledge and concerns gleaned from stakeholder involvement and could include:

- A description of the stakeholder / partnership process;
- A well-stated, overarching goal aimed at protecting, preserving, and restoring habitat and water quality, and encouragement of land stewardship;
- A plan to coordinate natural resource protection and planning efforts;
- A detailed and prioritized description of natural resource management objectives; and
- A detailed and prioritized discussion of best management practices, strategies and projects to be implemented by the partnership.

The U.S. Environmental Protection Agency has developed a list of 9 key elements that must be included in watershed projects submitted for Section 319 funding. These elements are discussed in Section 3.3 of this Plan.

Potential Water Quality Improvement Projects

GIS, hydrologic modeling and fuzzy logic were used to rank and prioritize the 10-digit HUC subwatersheds for known water quality concerns (Section 2, Watershed Classification). These rankings are used to identify where water quality improvement projects should be implemented to reduce nonpoint source pollution in the San Juan Watershed. This methodology ranked subwatersheds for four key nonpoint source water quality concerns:

1. Metals originating from abandoned mine sites;
2. Stream sedimentation due to land use activities;
3. Organic and nutrient pollution due to land use activities; and
4. Selenium due to agricultural practices.
Table 2-21 lists the subwatersheds in the San Juan Watershed and their final weighted risk evaluation (RE) scores for each of these four constituents. The rankings range from a low risk of 0.0 to higher risk values approaching 1.0. See Section 2 for a full discussion on the derivation of these values.

Based on these values, subwatersheds in Arizona that ranked among the highest for each of the types of nonpoint sources were selected for an example water quality improvement project.

The four example subwatersheds projects that will be discussed here are:

- Trading Post Wash-Chinle Wash for metals pollution;
- Nazlini Wash for sediment pollution;
- Red Water Wash-Chinle Wash; and,
- Trading Post Wash-Chinle Wash for selenium.

Example projects with best management practices to reduce metals, sediment, organic, nutrient and selenium pollution are discussed below. Management measures and their associated costs must be designed and calculated based on site-specific conditions.

Methods for calculating and documenting pollutant reductions for sediment, sediment-borne phosphorus and nitrogen, feedlot runoff, and commercial fertilizer, pesticides and manure utilization can be found on the NEMO web site in the Best Management Practices (BMP) Manual, under Links (www.ArizonaNEMO.org). It is expected that the local stakeholder partnership watershed-based plan will identify projects and locations important to their community, and may differ from the example project locations proposed here.

1. Trading Post Wash-Chinle Wash Subwatershed Example Project

**Pollutant Type and Source**

Metal-laden sediment originating from an abandoned tailings or spoil pile at an assumed abandoned mine site within the riparian area.

The Trading Post Wash-Chinle Wash Subwatershed was ranked as the most critical area in the San Juan Watershed impacted by metals related to abandoned mine sites (i.e. highest risk evaluation (RE) value for metals), and a project to control the movement of metal-laden sediment is recommended. All of the land within this subwatershed is on Navajo Nation land. Projects implemented on tribal lands must obtain the permission of the owner and must comply with all local, state and federal permits. In addition, projects implemented on private lands must meet the same permit obligations and notification requirements.

**Load Reductions**

Calculate and document sediment delivery and pollutant reductions for sediment-borne metals using Michigan DEQ (1999) methodology (found in the NEMO BMP Manual under “Links”). Although this manual addresses sediment reduction with respect to nutrients, the
methods can be applied when addressing metals. Particulate metals that generate dissolved metals in the water column and dissolved metals have a tendency to behave like nutrients in the water column.

Management Measures

Various options are available to restore a mine site, ranging from erosion control fabrics and revegetation to the removal and relocation of the tailings material. Table 3-1 presents these management measures along with associated load reduction potential, maintenance, and anticipated costs. It should be recognized that only after a site-specific evaluation can the best treatment option be identified and that the installation of engineered erosion control systems and/or the relocation of the tailings will necessitate project design by a licensed engineer.

2. Nazlini Wash Subwatershed Example Project

Pollutant Type and Source:

Sediment pollution due to overgrazing.

The Nazlini Wash subwatershed of the San Juan Watershed ranked as the most critical subwatershed in Arizona impacted by land use activities, and for purposes of outlining an example project it will be assumed that cattle grazing in the uplands and within the riparian area have exacerbated erosion. The exclusive land owner within this subwatershed (Table 1-2) is the Navajo Nation. Projects implemented on tribal lands must obtain the permission of the owner and must comply with all local, state and federal permits.

Load Reductions

In Nazlini Wash, sediment is assumed to most likely originate from grazing practices because rangeland livestock grazing is the primary land use in this portion of the San Juan Watershed. Load reductions can be calculated and documented for sediment using Michigan DEQ (1999) methodology (see the NEMO BMP Manual).

Management Measures

Implementing grazing management practices to improve or maintain upland and riparian health will help reduce excess surface runoff and accelerated erosion. Management may include pasture rotation, exclusion of the land from grazing and/or restricting access to riparian corridors by fencing, which will also reduce the introduction of fecal matter to the stream.

Alternative watering facilities at a location removed from the waterbody may be necessary. Table 3-2 presents load reduction potential, required maintenance, and anticipated costs associated with each project option. It should be recognized that only after a site-specific evaluation can the best treatment option be identified and that the installation of engineered erosion control systems and the installation of an alternative water source may necessitate project design by a licensed engineer.
3. Red Water Wash-Chinle Wash Example Project

Pollutant Type and Source

Organics and nutrients pollution due to low dissolved oxygen

The rural areas of the Red Water Wash-Chinle Wash Subwatershed generally do not have access to public waste water treatment and for this reason organic pollutants are assumed to originate from failing septic systems. However, livestock grazing and cattle watering in the stream channel may also contribute to the pollution concern. The exclusive land owner within the Red Water Wash-Chinle Wash subwatershed is the Navajo Nation (Table 1-2). Projects implemented on tribal lands must obtain the permission of the owner and must comply with all local, state, and federal permits.

Load Reduction

Low levels of dissolved oxygen are assumed to result from the introduction into the watershed of animal wastes from feedlots, dairies, and open the grazing of cattle. Load reductions of organic wastes can be calculated and documented for grazing runoff using Michigan DEQ (1999) methodology (see the NEMO BMP Manual).

Management Measures

Implementing grazing management practices to improve or maintain riparian health will help reduce organic pollutants. Management may include exclusion of the land from grazing and/or restricting access to riparian corridors by fencing, which will also reduce the introduction of fecal matter to the stream.

Alternative watering facilities at a location removed from the water body may be necessary. Table 3-2 present load reduction potential, required maintenance and anticipated costs associated with each project option. It should be recognized that only after a site-specific evaluation can the best treatment option be identified.

Failing septic systems can also result in partially treated or untreated surface wastewater containing organics and nutrients, causing nonpoint source pollution in drainage ways, streams, and lakes. The only practical long-term Best Management Practice would be to either upgrade individual septic systems by redesigning and replacing part or all of them, or requiring hook-up to a public wastewater treatment facility. This work must be done by a registered contractor or a business licensed to design and install individual sewage treatment systems, but the greatest constraint to this practice is the significant cost to the homeowner. The Arizona Water Infrastructure Finance Authority (WIFA) could be a source of low interest financing to rural communities seeking to upgrade their wastewater disposal systems to protect water supply, however requiring hook-up still results in costs to the homeowner.

Some locations experiencing rapid development across the state are putting into place ordinances requiring new development to install wastewater treatment facilities, but this does little to
address existing systems. Constructed wetland systems have been successfully applied in more humid regions of the country; in Arizona, shallow ground water would be necessary to sustain a constructed wetland treatment system. The constructed wetland system would consist of two shallow basins about 1 foot in depth and containing gravel, which supports emergent vegetation. The first of the two cells is lined to prevent seepage, while the second is unlined and acts as a disposal field. The water level is maintained below the gravel surface, thus preventing odors, public exposure, and vector problems. In an alternative design, a standard septic drain-tile field drain system could be used in place of the second cell.

4. Trading Post Wash-Chinle Wash Subwatershed Example Project

Pollutant Type and Source

Selenium pollution.

The Trading Post Wash-Chinle Wash subwatershed ranked as the most critical area for selenium pollution in the Arizona portion of the San Juan Watershed (Table 2-21).

For this example project it will be assumed that irrigation tail water has introduced elevated concentrations of selenium into the stream. The Navajo Nation is the only land owner in the Trading Post Wash-Chinle Wash subwatershed. Projects implemented on tribal lands must obtain the permission of the owner and must comply with all local, state and federal permits.

Load Reductions

Naturally occurring selenium is concentrated in water by evaporation, and also when irrigation water leaches selenium from the soil. To calculate the load reduction resulting from implementation of a best management practice, an estimate of the reduction in volume of irrigation tail water that returns to the stream is required.

Support for calculating load reductions can be obtained from the local Agricultural Research Service or County Cooperative Extension office (http://cals.arizona.edu/extension/).

Management Measures

Implementing agricultural irrigation practices to reduce tail water pollution will necessitate dramatic changes from the typical practice of flood irrigation. This may involve the installation of mechanized irrigation systems or on-site treatment.

As an example of a situation where drainage water must be managed, some watersheds in California have agricultural drainage water containing levels of selenium that approach the numeric criterion defining hazardous waste (above 1,000 parts per billion). This situation is being considered for permit regulation to manage drainage at the farm level (San Joaquin Valley Drainage Implementation Program, 1999).

Currently, Arizona is not considering such extreme measures, but selenium remains an important nonpoint source contaminant and a known risk to wildlife.
The use of treatment technologies to reduce selenium concentrations include ion exchange, reverse osmosis, solar ponds, chemical reduction with iron, microalgal-bacterial treatment, biological precipitation, and constructed wetlands. Engineered water treatment systems, however, may be beyond the scope of a proposed best management practices project, and technologies are still in the research stage.

The load reduction potential, maintenance, and anticipated costs associated with the installation of mechanized irrigation systems are discussed above. These types of systems allow for improved water conservation and improved management of limited water resources. It should be recognized that only after a site-specific evaluation can the best treatment option be identified and that the installation of mechanized irrigation systems involve capital expense and may necessitate project design by a licensed engineer.

**Technical and Financial Assistance**

Stakeholder-group local watershed-based plans should identify specific projects important to their partnership, and during the planning process should estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the plan. Technical support sources include NEMO, University of Arizona Cooperative Extension, government agencies, engineering contractors, volunteers, and other environmental professionals.

Funding sources may include:

- Clean Water Act Section 319(h) funds;
- State revolving funds through the Arizona Department of Environmental Quality;
- Central Hazardous Materials Fund;
- USDA Environmental Quality Incentives Program and Conservation Security Program;
- Arizona Water Protection Fund through the Arizona Department of Water Resources;
- Water Infrastructure Finance Authority;
- Arizona Heritage Fund through Arizona State Parks and Arizona Game and Fish; and
- Private donations or non-profit organization donations.

In addition to the extensive listing of funding and grant sources on the NEMO web site ([www.ArizonaNEMO.org](http://www.ArizonaNEMO.org)), searchable grant funding databases can be found at the EPA grant opportunity web site [www.grants.gov](http://www.grants.gov) or [www.epa.gov/owow/funding.html](http://www.epa.gov/owow/funding.html).

In Arizona, Clean Water Act Section 319(h) funds are managed by ADEQ and the funding cycle and grant application data can be found at: [http://www.azdeq.gov/environ/water/watershed/fin.html](http://www.azdeq.gov/environ/water/watershed/fin.html)

The Arizona legislature allocates funding to the Arizona Water Protection Fund. In
addition, the fund is supplemented by income generated by water-banking agreements with the Central Arizona Project. Information can be found at http://www.awpf.state.az.us/

Most grants require matching funds in dollars or in-kind services. In-kind services may include volunteer labor, access to equipment and facilities, and a reduction on fee schedules / rates for subcontracted tasks. Grant matching and cost share strategies allow for creative management of limited financial resources to fund a project.

Education and Outreach

An information/education component is an important aspect of the Stakeholder-group local watershed-based plan that will be used to enhance public understanding of the project and encourage early and continued participation in selecting, designing and implementing management measures.

The NEMO program offers each watershed partnership the opportunity to post information, fact sheets and status reports on the NEMO web site, and to announce important events on the NEMO calendar. In addition, a partnership can obtain guidance and technical support in designing an outreach program through the University of Arizona Cooperative Extension.

Implementation Schedules & Milestones

Necessary to the watershed planning process is a schedule for project selection, design, funding, implementation, reporting, operation and maintenance, and project closure. In the San Juan Watershed, 10-digit HUC subwatershed areas have been prioritized in this plan for potential water quality improvement projects, but other locations across the watershed may hold greater interest by the stakeholders for project implementation. Private land owners or partnerships of stakeholders may propose specific projects to respond to immediate water quality concerns, such as stream bank erosion exacerbated by a recent flooding event.

After project selection, implementation may be dependent on the availability of funds, and because of this most watershed partnerships find themselves planning around grant cycles. Table 3.4A depicts the planning process, and suggests that the stakeholder group may want to revisit the listing and ranking of proposed projects on a regular basis, giving the group the opportunity to address changing conditions.

As shown in the table, a ‘short’ one-year project actually may take as many as three years from conception, to implementation, and ultimate project closure. With the number of grants currently available in Arizona for water quality improvement projects, the watershed partnership may find themselves in a continual cycle of grant writing and project reporting, overlapping and managing several aspects of several projects simultaneously.
### Table 3.4A: Example Watershed Project Planning Schedule.

<table>
<thead>
<tr>
<th>Watershed Project Planning Steps</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholder-Group 319 Plan Development</td>
<td>1</td>
</tr>
<tr>
<td>Identify and rank priority projects</td>
<td>2</td>
</tr>
<tr>
<td>Grant Cycle Year 1: Select Project(s)</td>
<td>3</td>
</tr>
<tr>
<td>Project(s) Design, Mobilization, and Implementation</td>
<td>4</td>
</tr>
<tr>
<td>Project(s) Reporting and Outreach</td>
<td>5</td>
</tr>
<tr>
<td>Project(s) Operation and Maintenance, Closure</td>
<td>1</td>
</tr>
<tr>
<td>Grant Cycle Year 2: Select Project(s)</td>
<td>2</td>
</tr>
<tr>
<td>Project(s) Design, Mobilization, and Implementation</td>
<td>3</td>
</tr>
<tr>
<td>Project(s) Reporting and Outreach</td>
<td>4</td>
</tr>
<tr>
<td>Project(s) Operation and Maintenance, Closure</td>
<td>5</td>
</tr>
<tr>
<td>Revisit Plan, Identify and re-rank priority projects</td>
<td>1</td>
</tr>
<tr>
<td>Grant Cycle Year 3: Select Project(s)</td>
<td>2</td>
</tr>
<tr>
<td>Project(s) Design, Mobilization, and Implementation</td>
<td>3</td>
</tr>
<tr>
<td>Project(s) Reporting and Outreach</td>
<td>4</td>
</tr>
<tr>
<td>Project(s) Operation and Maintenance, Closure</td>
<td>5</td>
</tr>
</tbody>
</table>

Most funding agencies operate on a reimbursement basis and will require reporting of project progress and reimbursement on a percent completion basis. In addition, the individual project schedule should be tied to important measurable milestones which should include both project implementation milestones and pollutant load reduction milestones. Implementation milestones may include interim tasks, such as shown in Table 3.4B, and can be tied to grant funding-source reporting requirements.

Based on funding availability, the activities outlined in Table 3.4B could be broken down into three separate projects based on location (Stream Channel, Stream Bank or Flood Plain), or organized into activity-based projects (Wildcat Dump Cleanup, Engineered Culverts, etc).
Table 3.4B - Example Project Schedule.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
<th>Implementation Milestone</th>
<th>Area 1 Stream Channel</th>
<th>Area 2 Stream Bank</th>
<th>Area 3 Flood Plain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1: Contract Administration</td>
<td>04/01/05 Thru 09/31/06</td>
<td>Contract signed Quarterly reports Final report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 2: Wildcat Dump Clean-up</td>
<td>04/01/05 Thru 07/05/05</td>
<td>Select &amp; Advertise Clean-up date Schedule Containers and removal</td>
<td>Remove hazardous materials from stream channel 100% hazardous material removal</td>
<td>Remove tires and vehicle bodies from streambank 100% hazardous material removal</td>
<td></td>
</tr>
<tr>
<td>Task 3: Engineering Design</td>
<td>04/01/05 Thru 08/15/05</td>
<td>Conceptual design select final design based on 75% load reduction</td>
<td>Gabions, culverts, calculate estimated load reduction</td>
<td></td>
<td>Re-contour, regrade, berms, water bars, gully plugs calculate estimated load reduction</td>
</tr>
<tr>
<td>Task 4: Permits</td>
<td>04/01/05 Thru 09/01/05</td>
<td>Confirm permit requirements and apply for necessary permits</td>
<td>US Army Corps of Engineers may require permits to conduct projects within the stream channel</td>
<td>Local government ordinances as well as the US Army Corps and State Historical Preservation permits may be needed.</td>
<td>In addition to local and State permits, the presence of listed or Endangered Species will require special permitting and reporting.</td>
</tr>
<tr>
<td>Task 5: Monitoring</td>
<td>07/05/05 thru 10/31/06</td>
<td>Establish photo points and water quality sample locations</td>
<td>Turbidity sampling, baseline and quarterly, compare to anticipated 75% Sediment load reduction</td>
<td>Photo points, baseline and quarterly, Calculate Sediment load reduction</td>
<td>Photo points, baseline and quarterly, Calculate Sediment load reduction</td>
</tr>
<tr>
<td>Task 6: Revegetation</td>
<td>08/15/05 thru 09/15/05</td>
<td>Survey and select appropriate vegetation</td>
<td></td>
<td>Willows, native grasses, cotton wood, mulch</td>
<td></td>
</tr>
</tbody>
</table>
### Management Measures and Implementation Schedule

**Streambank Stabilization and Estimated Load Reduction**

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
<th>Implementation Milestone</th>
<th>Water Quality Milestone</th>
<th>Area 1 Stream Channel</th>
<th>Area 2 Stream Bank</th>
<th>Area 3 Flood Plain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 7: Mobilization</td>
<td>09/01/05 thru 10/31/05</td>
<td>Purchase, delivery and installation of engineered structures and revegetation material</td>
<td>Install gabions, resized culverts / professional and volunteer labor</td>
<td>Regrade, plant vegetation with protective wire screens around trees / install gully plugs and water bars, volunteer labor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 8: Outreach</td>
<td>04/01/05 thru 10/31/06</td>
<td>Publication of news articles, posters, monthly reports during stakeholder-group local watershed meetings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 9: Operation and Maintenance</td>
<td>09/01/05 thru 10/31/06</td>
<td>Documentation of routine operation and maintenance in project quarterly reports during contract period, continued internal record keeping after contract / project closure</td>
<td>Maintenance and routine repair of engineered structures</td>
<td>Maintenance / irrigation of new plantings until established, removal of weeds and invasive species</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Evaluation Criteria

The evaluation section of a watershed plan will provide a set of criteria that can be used to determine whether progress towards individual project goals is being achieved and/or the effectiveness of implementation is meeting expectations. These criteria will help define the course of action as milestones and monitoring activities are being reviewed.

The estimate of the load reductions expected for each of the management measures or best management practices to be implemented is an excellent criterion against which progress can be measured. Prior to project implementation, baselines should be established to track water quality improvements, and standard measurement protocols should be established so as to assure measurement methodology does not change during the life of the project.

To evaluate the example project outlined in Table 3.4B, the following key evaluation attributes must be met:
• Schedule and timeliness: Grant applications, invoices and quarterly reports must be submitted to the funding source when due or risk cancellation of contracts. If permits are not obtained prior to project mobilization, the project crew may be subject to penalties or fines.

Compliance with standards: Engineered designs must meet the standards of the Arizona State Board of Technical and Professional Registration, Engineering Board of Licensing; water quality analytical work must be in compliance with State of Arizona Laboratory Certification. Excellent evaluation criteria would include engineer-stamped ‘as-built’ construction diagrams and documentation of laboratory certification, for example. Methods for estimating load reduction must be consistent with established methodology, and the means by which load reductions are calculated throughout the life of the plan must be maintained.

• Documentation and reporting: Field note books, spread sheets, and data reporting methodology must remain consistent throughout the project. Photo point locations must be permanently marked so as to assure changes identified over the life of the project are comparable. If the frequency of data collection changes or the methodology of reporting changes in the midst of the project, the project and overall plan loses credibility.

The project is a near success if the reports are on time, the engineered structures do not fail, data are reported accurately, and an independent person reviewing your project a year after project closure understands what was accomplished. The project is a full success if water quality improvement and load reductions have been made.

The criteria for determining whether the overall watershed plan needs to be revised are an appropriate function of the evaluation section as well. For example, successful implementation of a culvert redesign may reduce the urgency of a stream bank stabilization project downstream from the culvert, allowing for reprioritization of projects.

It is necessary to evaluate the progress of the overall watershed plan to determine effectiveness, project suitability, or the need to revise goals, BMPs or management measures. The criteria used
to determine whether there has been success, failure or progress will also determine if objectives, strategies or plan activities need to be revised, as well as the watershed-based plan itself.

**Effectiveness Monitoring**

Monitoring of watershed management activities is intrinsically linked to the evaluation performed within the watershed because both track effectiveness. While monitoring evaluates the effectiveness of implementation measures over time, the criteria used to judge success/failure/progress is part of the Evaluation process.

Following the example of the project outlined in Table 3.4B, other water quality and watershed health constituents to be monitored include:

- **Turbidity.** Measuring stream turbidity before, during and after project implementation will allow for quantification of load reduction.

- **Stream flow and volume, presence or absence of flow in a wash following precipitation.** Monitoring of these attributes is important especially after stream channel hydromodification.

- **Presence / absence of waste material.** This can be monitored with photo-points.

- **Riparian health, based on diversity of vegetation and wildlife.** Monitoring can include photo-points, wildlife surveys and plant mapping.

The monitoring section will determine if the partnership’s watershed strategies/management plan is successful, and/or the need to revise implementation strategies, milestones or schedule. It is necessary to evaluate the progress of the plan to determine effectiveness, unsuitability, or need to revise goals or BMPs.

Water quality monitoring for chemical constituents that may expose the sampler to hazardous conditions will require appropriate health and safety training and the development of a Quality Assurance Project Plan (QAPP). Monitoring for metals derived from abandoned mine sites, pollutants due to organics, nutrients derived from land use, and selenium will require specialized sample collection and preservation techniques, in addition to laboratory analysis. Monitoring for sediment load reduction may be implemented in the field without extensive protocol development.

Resources to design a project monitoring program can be found at the EPA water quality and assessment web site: [www.epa.gov/owow/monitoring/](http://www.epa.gov/owow/monitoring/) as well as through the Master Watershed Steward Program available through the local county office of University of Arizona Cooperative Extension. In addition, ADEQ will provide assistance in reviewing a QAPP and monitoring program.
Conclusions

This watershed-based plan ranked 10-digit HUC subwatersheds within the San Juan Watershed for risk of water quality degradation from nonpoint source pollutants (Section 2 and Table 2-18). This ranking was based on Arizona’s Integrated 305(b) Water Quality Assessment and 303(d) Listing Report, for the San Juan Watershed (ADEQ, 2008).

In addition to the subwatershed classifications, this plan contains information on the natural resources and socio-economic characteristics of the watershed (Section 1). Based on the results of the Classification in Section 2, example best management practices and water quality improvement projects to reduce nonpoint source pollutants are also provided (Section 3).

The subwatershed rankings were determined for the four major constituent groups (metals, sediment, organics and selenium) using fuzzy logic (see Section 2 for more information on this methodology and the classification procedure). The final results are summarized in this section and are shown in Table 2-18. In addition, technical and financial assistance to implement the stakeholder-group local watershed-based plans are outlined in this section.

Of the subwatersheds included in this assessment, those for which example projects were described were the following:

- Trading Post Wash-Chinle Wash for metals pollution;
- Nazlini Wash for sediment pollution;
- Red Water Wash-Chinle Wash; and,
- Trading Post Wash-Chinle Wash for selenium.

This NEMO Watershed-Based Plan is consistent with EPA guidelines for CWA Section 319 Nonpoint Source Grant funding. The nine planning elements required to be eligible for 319 grant funding are discussed, including education and outreach, project scheduling and implementation, project evaluation, and monitoring.

Some basic elements are common to almost all forms of planning: data gathering, data analysis, project identification, implementation and monitoring. It is expected that local stakeholder groups and communities will identify specific projects important to their partnership, and will rely on the NEMO Plan in developing their own plans.

Summary of EPA’s 9 Key Elements

Introduction

All projects that apply for Section 319 funding under the Clean Water Act and administered through the Arizona Department of Environmental Quality must include nine key elements in their watershed-based plans. These elements are listed in Section 1 of this Watershed-Based Management Plan and are also discussed in the Nonpoint Source Guidance Document by the US EPA (http://www.epa.gov/owow/nps/319/index.html).
The nine key elements are described below and the corresponding sections of this NEMO Watershed-Based Management Plan are noted. Information and data to support this requirement can be found in these sections of this Plan.

**Element 1: Causes and Sources**

Found in NEMO Watershed-Based Plan – Section 2

The watershed-based plan must identify the sources that will need to be controlled to achieve load reductions established in the nonpoint source TMDL.

In addition, pollutants of concern must be identified, and the causes and sources (primary and secondary) of waterbody impairment (physical, chemical, and biological, both point and non-point sources) must be linked to each pollutant of concern.

Section 2 of the NEMO Watershed-based management plan prioritizes the subwatersheds for risk of impairment due to metals, sediment, organics and selenium nonpoint source pollution. In addition, the potential causes for each constituent are described so that the watershed group can begin identifying the source of the risk.

**Element 2: Expected Load Reductions**

Not included in NEMO Plan, must be calculated based on site-specific and project-specific attributes.

The plan must contain an overview of TMDL load reductions expected for each Best Management Practice, linked to an identifiable source (only required for sediment (tons/yr), nitrogen or phosphorus (lbs/yr)). See the NEMO website in the Best Management Practices (BMP) Manual under Links (www.ArizonaNEMO.org) for calculation methods.

**Element 3: Management Measures**

Found in NEMO Watershed-Based Plan – Section 3

The plan must contain a description of the nonpoint source Best Management Practices or management measures and associated costs needed to achieve load reductions for the critical areas identified in which the measures will need to be implemented to achieve the nonpoint source TMDL.

Section 3 Strategy for Addressing Existing Impairments of the NEMO plan describes a variety of nonpoint source BMPs that may be applied for load reduction and management of metals, sediment, organics and selenium pollution.

Section 3 Potential Water Quality Improvement Projects includes an example water quality improvement project for each of the four constituents (metals, sediment, organics and selenium) with specific example management measures.
Element 4: Technical and Financial Assistance

Found in NEMO Watershed-Based Plan – Section 3 and NEMO website www.ArizonaNEMO.org

The plan must include an estimate of the technical and financial assistance needed, including associated costs, and funding strategy (funding sources), and authorities the state anticipates having to rely on to implement the plan.

Section 3 includes several tables that include various management measures and their relative costs, life expectancy and load reduction potential.

Section 3 Technical and Financial Assistance includes a list of possible funding sources and links for water quality improvement projects. In addition, the NEMO website (www.ArizonaNEMO.org) has an extensive list of links to a wide variety of funding sources.

Element 5: Information / Education Component

Example found in NEMO Watershed-Based Plan - Section 3

This is the information/education component intended to enhance public understanding and participation in selecting, designing, and implementing the nonpoint source management measures, including the outreach strategy with long and short term goals, and funding strategy.

Section 3 Education and Outreach lists local resources that may be valuable in education and outreach to the local community or other targeted audiences. In addition, examples of local educational outreach projects are presented.

Element 6: Schedule

Example found in NEMO Watershed-Based Plan - Section 3

The plan must include a schedule for implementing, operating and maintaining the nonpoint source Best Management Practices identified in the plan.

Section 3 Implementation Schedules & Milestones describes the importance of schedules in a water quality improvement project and presents an example schedule.

Element 7: Measurable Milestones

Example found in NEMO Watershed-Based Plan - Section 3

The plan must include a schedule of interim, measurable milestones for determining whether nonpoint source Best Management Practices or other control actions are being implemented and water quality improvements are occurring.

Section 3 Implementation Schedules & Milestones describes some measurable milestones and presents an example schedule that includes milestones.

Element 8: Evaluation of Progress

Example found in NEMO Watershed-Based Plan - Section 3
The plan must contain a set of criteria used to determine whether load reductions are being achieved and substantial progress is being made towards attaining water quality standards, including criteria for determining whether the plan needs to be revised or if the Total Maximum Daily Load (TMDL) needs to be revised.

Section 3 Evaluation Criteria describes how to evaluate the progress and success of a water quality improvement project and describes the key attributes that must be met for a successful project.

*Element 9: Effectiveness Monitoring*

Example found in NEMO Watershed-Based Plan - Section 3

The plan must include a monitoring plan to evaluate the effectiveness of implementation efforts over time, measured against the set of criteria established in the Evaluation of Progress element (8).

Section 3 Effectiveness Monitoring discusses the importance of project monitoring, and presents several example water quality and health constituents that should be monitored.

**Conclusions**

The NEMO Watershed based plans are structured to be a watershed wide, broad evaluation of the nine key elements. The community watershed groups, as they apply for 319 Grant Funds to implement projects, will need to readdress each of these 9 key elements for their specific site and watershed project.
References


Data Sources*:

Arizona State Land Department, Arizona Land Resource Information System (ALRIS), http://www.land.state.az.us/alris/index.html


*Note: Dates for each data set refer to when data was downloaded from the website. Metadata (information about how and when the GIS data were created) is available from the website in most cases and is also found on the NEMO IMS website (www.ArizonaNEMO.org). Metadata includes the original source of the data, when it was created, it’s geographic projection and scale, the name(s) of the contact person and/or organization, and general description of the data.