Section 8: Local Watershed Planning

The first component of the planning process is to summarize all readily available natural resource information and other data for a given watershed. As seen in Sections 2 though 5 of this watershed-based planning 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 area within the NEMO Watershed-based Plan, or include the entire 6-digit HUC watershed area.

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

- A detailed and prioritized discussion of best management practices, strategies and projects to be implemented by the partnership.

EPA’s 2003 Guidelines for the Award of Section 319 Nonpoint Source Grants (EPA, 2003) suggests that a watershed-based plan should include all nine elements listed in Section 1 of this document to be considered for funding. The nine planning elements help provide reasonable assurance that the nonpoint source of pollution will be managed to improve and protect water quality, and to assure that public funds to address impaired waters are used effectively.

Potential Water Quality Improvement Projects

GIS, hydrologic modeling and fuzzy logic were used to rank and prioritize the 10-digit HUC subwatersheds most susceptible to known water quality concerns (Section 6, Watershed Classification). These rankings are used to identify where water quality improvement projects should be implemented to reduce nonpoint source pollution. This methodology ranked 31 subwatersheds for four key nonpoint source water quality concerns:

- metals originating from abandoned mine sites;
- stream sedimentation due to land use activities;
- organic and nutrient pollution due to land use activities; and
- selenium due to agricultural practices.
Table 8-1 shows all 21 subwatersheds and their final weighted fuzzy membership value for each of these four constituents. Values highlighted in bold and with a shaded box indicate high risk for water quality degradation. The highest ranking value in each category is highlighted with a bold cell outline. The rankings range from a low risk of 0.0 to higher values approaching 1.0. See Section 6 for a full discussion on the derivation of these values.

Table 8-1. Summary of Weighted Fuzzy Membership Values for each Subwatershed.

<table>
<thead>
<tr>
<th>Subwatershed Name</th>
<th>Metals WFMV&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Sediment WFMV&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Organics WFMV&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Selenium WFMV&lt;sup&gt;4&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markham Wash</td>
<td>0.273</td>
<td>0.390</td>
<td>0.701</td>
<td>0.160</td>
</tr>
<tr>
<td>Muddy Creek</td>
<td>0.248</td>
<td>0.640</td>
<td>0.652</td>
<td>0.150</td>
</tr>
<tr>
<td>Willow Creek</td>
<td>0.330</td>
<td>0.580</td>
<td>0.847</td>
<td>0.380</td>
</tr>
<tr>
<td>Trout Creek</td>
<td>0.060</td>
<td>0.500</td>
<td>0.457</td>
<td>0.010</td>
</tr>
<tr>
<td>Knight Creek</td>
<td>0.850</td>
<td>0.520</td>
<td>0.887</td>
<td>0.320</td>
</tr>
<tr>
<td>Upper Big Sandy River</td>
<td>0.910</td>
<td>0.480</td>
<td>0.678</td>
<td>0.480</td>
</tr>
<tr>
<td>Middle Big Sandy River</td>
<td>0.790</td>
<td>0.410</td>
<td>0.623</td>
<td>0.560</td>
</tr>
<tr>
<td>Lower Big Sandy River</td>
<td>0.760</td>
<td>0.240</td>
<td>0.620</td>
<td>0.160</td>
</tr>
<tr>
<td>Francis Creek</td>
<td>0.270</td>
<td>0.550</td>
<td>0.616</td>
<td>0.150</td>
</tr>
<tr>
<td>Upper Burro Creek</td>
<td>0.330</td>
<td>0.680</td>
<td>0.619</td>
<td>0.150</td>
</tr>
<tr>
<td>Boulder Creek</td>
<td>0.940&lt;sup&gt;5&lt;/sup&gt;</td>
<td>0.760</td>
<td>0.710</td>
<td>0.150</td>
</tr>
<tr>
<td>Lower Burro Creek</td>
<td>0.880</td>
<td>0.640</td>
<td>0.498</td>
<td>0.0370</td>
</tr>
<tr>
<td>Kirkland Creek</td>
<td>0.910</td>
<td>0.810</td>
<td>0.964</td>
<td>0.010</td>
</tr>
<tr>
<td>Sycamore Creek</td>
<td>0.282</td>
<td>0.720</td>
<td>0.606</td>
<td>0.650</td>
</tr>
<tr>
<td>Upper Santa Maria River</td>
<td>0.910</td>
<td>0.640</td>
<td>0.834</td>
<td>0.160</td>
</tr>
<tr>
<td>Date Creek</td>
<td>0.478</td>
<td>0.370</td>
<td>0.622</td>
<td>0.320</td>
</tr>
<tr>
<td>Lower Santa Maria River</td>
<td>0.700</td>
<td>0.550</td>
<td>0.728</td>
<td>0.050</td>
</tr>
<tr>
<td>Bullard Wash</td>
<td>0.735</td>
<td>0.260</td>
<td>0.732</td>
<td>0.010</td>
</tr>
<tr>
<td>Alamo Lake - Bill Williams River</td>
<td>1.000&lt;sup&gt;6&lt;/sup&gt;</td>
<td>0.380</td>
<td>0.796</td>
<td>0.180</td>
</tr>
<tr>
<td>Mohave Wash</td>
<td>0.308</td>
<td>0.350</td>
<td>0.504</td>
<td>0.250</td>
</tr>
<tr>
<td>Castaneda Wash - Bill Williams River</td>
<td>0.490</td>
<td>0.420</td>
<td>0.333</td>
<td>0.750</td>
</tr>
</tbody>
</table>

Notes:
1. Values greater than 0.49 indicate High Priority for Metals (shaded boxes), Table 6-6, Figure 6-2.
2. Values greater than 0.50 indicate High Priority for Sediment (shaded boxes), Table 6-12, Figure 6-3.
3. Values greater than 0.68 indicate High Priority for Organics (shaded boxes), Table 6-15, Figure 6-4.
4. Values greater than 0.32 indicate High Priority for Selenium (shaded boxes), Table 6-18, Figure 6-5.
5. Boulder Creek has a TMDL plan in place with recommended projects to address metals so the Upper Big Sandy River Subwatershed is selected for example project implementation.
6. Alamo Lake is heavily influenced by upstream conditions; Upper Big Sandy River Subwatershed is selected for example project implementation.
Based on these fuzzy membership values, the subwatershed that ranked the highest for each of the nonpoint sources was selected for an example water quality improvement project. The four example subwatershed projects that will be discussed here are:

1. Upper Big Sandy River, for metals pollution;

2. Kirkland Creek, for sediment pollution;

3. Kirkland Creek, for pollutants due to organics and nutrients derived from land use; and

4. Castaneda Wash – Bill Williams River, for selenium due to agricultural practices.

Example projects with best management practices to reduce sediment, metals, organic, nutrient and selenium pollution are discussed below. Management measures and their associated costs must be designed and calculated based on site-specific conditions; however, sample costs are included in Section 7.

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. Upper Big Sandy River – 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 Upper Big Sandy River subwatershed ranked as one of the most critical areas in the Bill Williams Watershed impacted by metals related to an abandoned mine site (i.e. third highest fuzzy membership value for metals; Alamo Lake (first) is heavily influence by upstream conditions and Boulder Creek (second) already has a TMDL plan), and a project to control the movement of metal-laden sediment is recommended. The land owners within this subwatershed include the U.S. Bureau of Land Management (51.21%), State Trust Lands of Arizona (11.64%), and private owners (37.12%, Table 7-2). Projects implemented on private, federal or state lands must obtain the permission of the owner and must comply with all local, state and federal permits.

   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 an abandoned mine site, ranging from erosion control fabrics and revegetation to the removal and relocation of the tailings material. Section 7 and Table 7-1 present 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 - 3. Kirkland Creek Example Projects

Pollutant Type and Source:
(1) Sediment pollution due to grazing, and (2) organic pollutants, specifically E. coli, assumed to originate from cattle watering in the stream channel.

The Kirkland Creek subwatershed of the Bill Williams River watershed ranked as the most critical area impacted by land use activities. It had the highest fuzzy membership values for both sediment and organics, both of which are highly correlated to land use activities (Table 8-1).

For this example project it will be assumed that grazing within the riparian area has exacerbated erosion (sediment pollution) and introduced fecal matter into the stream (organic pollution in the form of E. coli). The land owners within this subwatershed (Table 7-2) include the U.S. Forest Service (18.29%), U.S. Bureau of Land Management (3.3%), private owners (32.46%), and State Trust lands (45.89%). Projects implemented on private, federal or state lands must obtain the permission of the owner and must comply with all local, state and federal permits.

Load Reductions:
The goal of this example project is to reduce both sediment and bacterial (organic) pollution to the Kirkland Creek subwatershed. Sediment load reductions can be calculated and documented using the Michigan DEQ (1999) methodology, available at the NEMO website, under BMP Manual, Links (www.ArizonaNEMO.org).

Prior to initiating a project to reduce E. coli bacteria pollution, it may benefit the watershed partnership to determine the source of the bacterial contamination. The field of bacteria source tracking continues to evolve rapidly and there are numerous methods available, each of which has its limitations and benefits.

Despite the rapid and intensive research into existing methods, EPA recommends that bacteria source tracking “should be used by federal and state agencies to address sources of fecal pollution in water... [because it] represents the best tools available to determine pathogen TMDL load allocations and TMDL implementation plan development” (EPA, 2001). For example, implementation of DNA fingerprinting technology will identify the actual sources of bacterial and clarify how best to target an implementation plan and project.
The results of a study funded from Section 319 Nonpoint Source Grant funds for Oak Creek Canyon within the Verde Watershed found that most of the fecal pollution came from natural animal populations in the canyon with sporadic and seasonal impacts from human, dog, cattle, house and llama sources (NAU, 2000). The Oak Creek Task Force (a locally led watershed group) suggested implementing locally approved grazing modifications to decrease the inflow of sediment carrying fecal material, as well as public education and increased toilet facilities within the canyon to reduce nonpoint source bacterial pollutants.

In Kirkland Creek, pathogens and sediment are assumed to most likely originate from grazing practices because livestock grazing is one of the primary land uses. However, recent development in the Peeples Valley - Yarnell area has increased the number of septic systems in the area which may also contribute to the presence of pathogens. For this project example it is assumed that load reduction should concentrate on grazing management.

Management Measures:
Implementing grazing management practices to improve or maintain riparian health will help reduce excess surface runoff and accelerated erosion, and reduce the amount of bacterial pollution to the stream. Sustainable livestock grazing can be achieved in all plant communities by changing the duration, frequency and intensity of grazing.

In addition, livestock 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 waterbody may be necessary. Section 7 discusses these management measures. Tables 7-3 and 7-4 present load reduction potential, required maintenance and anticipated costs associated with various management options. 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 or the installation of an alternative water source may necessitate project design by a licensed engineer.

4. Castaneda Wash – Bill Williams River Subwatershed Example Project

Pollutant Type and Source: Selenium pollution due to flood irrigation practices.

The Castaneda Wash – Bill Williams River subwatershed of the Bill Williams River ranked as the most critical area impacted by agricultural land use practices that exacerbate the concentration of naturally occurring selenium (i.e. highest fuzzy membership values for Selenium, Table 8-1). For this example project it will be assumed that irrigation tail water has introduced elevated concentrations of selenium into the stream. The land owners within this subwatershed (Table 7-2) include the U.S. Bureau of Land Management (80.27%), private owners (15.75%), State Trust lands (<1%), National Park Service (<1%) and U.S. Fish and Wildlife Service (2.9%). Projects implemented on
private, federal or state 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.

In some watersheds in California, agricultural drainage water contains 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, microalgae-bacterial treatment, biological precipitation, and constructed wetlands. Engineered water treatment systems may be beyond the scope of a proposed best management practices project, and technologies are still in the research stage.

Section 7 outlines load reduction potential, maintenance, and anticipated costs associated with the installation of mechanized irrigation systems. 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. Mechanized irrigation, however, allows for improved water conservation and improved management of limited water resources.

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 though 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), searchable grant funding databases can be found at the EPA grant opportunity web site www.grants.gov or 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.

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 Upper Bill Williams Partnership is currently the only partnership that has formed within the Bill Williams River Watershed. The Upper Bill Williams Partnership concentrates on the Kirkland Creek subwatershed and meetings have been held in Skull Valley.

To increase stakeholder participation, outreach and public education activities need to be initiated within the watershed, such as sponsoring a booth at the County Fair. Working with other Cooperative Extension programs, such as Project WET (Water Education for Teachers, K-12 classroom education), the booth provided
displays, posters, and fact sheets on important water topics in addition to individual water quality improvement projects.

The NEMO program offers each watershed partnership the opportunity to post fact sheets and status reports on the NEMO web site, and to announce important events on the NEMO calendar (www.ArizonaNEMO.org). 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 Castaneda Wash – Bill Williams River, the Kirkland Creek and Upper Big Sandy River 10-digit HUC subwatershed areas have been prioritized 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 8-2 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.

**Table 8-2: 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></td>
</tr>
<tr>
<td>Identify and rank priority projects</td>
<td></td>
</tr>
<tr>
<td>Grant Cycle Year 1: Select Project(s)</td>
<td></td>
</tr>
<tr>
<td>Project(s) Design, Mobilization, and Implementation</td>
<td>X</td>
</tr>
<tr>
<td>Project(s) Reporting and Outreach</td>
<td>X</td>
</tr>
<tr>
<td>Project(s) Operation and Maintenance, Closure</td>
<td>X</td>
</tr>
<tr>
<td>Grant Cycle Year 2: Select Project(s)</td>
<td></td>
</tr>
<tr>
<td>Project(s) Design, Mobilization, and Implementation</td>
<td>X</td>
</tr>
<tr>
<td>Project(s) Reporting and Outreach</td>
<td>X</td>
</tr>
<tr>
<td>Project(s) Operation and Maintenance, Closure</td>
<td>X</td>
</tr>
<tr>
<td>Revisit Plan, Identify and re-rank priority projects</td>
<td>X</td>
</tr>
<tr>
<td>Grant Cycle Year 3: Select Project(s)</td>
<td></td>
</tr>
<tr>
<td>Project(s) Design, Mobilization, and Implementation</td>
<td>X</td>
</tr>
<tr>
<td>Project(s) Reporting and Outreach</td>
<td>X</td>
</tr>
<tr>
<td>Project(s) Operation and Maintenance, Closure</td>
<td>X</td>
</tr>
</tbody>
</table>
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.

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 8-3, and can be tied to grant funding-source reporting requirements.

Based on funding availability, the activities outlined in Table 8-3 could be broken down into three separate projects based on location (Stream Channel, Stream Bank, and Flood Plain), or organized into activity-based projects (Wildcat Dump Cleanup, Engineered Culverts, etc).

Table 8-3: Example Project Schedule

| Task 1: Contract Administration | 04/01/05 Thru 09/31/06 | Contract signed Quarterly reports Final report |
| Task 2: Wildcat Dump Clean-up | 04/01/05 Thru 07/05/05 | Select & Advertise Clean-up date Schedule Containers and removal |
| Task 3: Engineering Design | 04/01/05 Thru 08/15/05 | Conceptual design, select final design based on 75% load reduction |

| Water Quality Milestone | Target Load Reduction: 100% Hazardous Materials 75% Sediment Load |
| Area 1 Stream Channel | Area 2 Stream Bank | Area 3 Flood Plain |
| Remove hazardous materials from stream channel 100% hazardous material removal | Remove tires and vehicle bodies from streambank 100% hazardous material removal |  
| Gabions, culverts, calculate estimated load reduction | Re-contour, regrade, berms, water bars, gully plugs, calculate estimated load reduction. |
### Management Measures and Implementation Schedule
#### Streambank Stabilization and Estimated Load Reduction

<table>
<thead>
<tr>
<th>Task/Measurement</th>
<th>Start Date</th>
<th>End Date</th>
<th>Implementation Milestone</th>
<th>Water Quality Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task 4: Permits</strong></td>
<td>04/01/05</td>
<td>09/01/05</td>
<td>Confirm permit requirements and apply for necessary permits</td>
<td>Area 1 Stream Channel (US Army Corps of Engineers may require permits to conduct projects within the stream channel)</td>
</tr>
<tr>
<td><strong>Task 5: Monitoring</strong></td>
<td>07/05/05</td>
<td>10/31/06</td>
<td>Establish photo points and water quality sample locations</td>
<td>Area 2 Stream Bank (Local government ordinances as well as the US Army Corps and State Historical Preservation permits may be needed.)</td>
</tr>
<tr>
<td><strong>Task 6: Revegetation</strong></td>
<td>08/15/05</td>
<td>09/15/05</td>
<td>Survey and select appropriate vegetation</td>
<td>Area 3 Flood Plain (In addition to local and State permits, the presence of listed or Endangered Species will require special permitting and reporting.)</td>
</tr>
<tr>
<td><strong>Task 7: Mobilization</strong></td>
<td>09/01/05</td>
<td>10/31/05</td>
<td>Purchase, delivery and installation of engineered structures and revegetation material</td>
<td>Willows, native grasses, cotton wood, mulch</td>
</tr>
<tr>
<td><strong>Task 8: Outreach</strong></td>
<td>04/01/05</td>
<td>10/31/06</td>
<td>Publication of news articles, posters, monthly reports during stakeholder-group local watershed meetings</td>
<td>Regrade, plant vegetation with protective wire screens around trees / install gully plugs and water bars, volunteer labor</td>
</tr>
<tr>
<td><strong>Task 9: Operation and Maintenance</strong></td>
<td>09/01/05</td>
<td>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>
</tr>
</tbody>
</table>
Evaluation

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 8-2, 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 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.

• Consistency of measurement: The plan should identify what is being measured, the units of measurement, and the standard protocol for obtaining measurements. For example, turbidity can be measured in ‘Nephelometric Units’ or more qualitatively with a Siche disk. Water volume can be measured as Acre/feet, gallons, or cubic feet. Failure to train project staff to perform field activities consistently and to use comparable units of measure can result in project failure.

• Documentation and reporting: Field note books, spreadsheets, 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.

**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.

Watershed monitoring will include the water quality data reported in Arizona's Integrated 305(b) Assessment Report (ADEQ, 2002), but the overall stakeholder group watershed plan will identify additional data collection activities that are tied to stakeholder concerns and goals. For the Castaneda Wash – Bill Williams River, Kirkland Creek and Upper Big Sandy River subwatersheds are identified as vulnerable to water quality impairment due to metals, organics and nutrients, and selenium. Monitoring of stream reaches within the Bill Williams River (Castaneda Wash – Bill Williams River), Santa Maria River (Kirkland Creek) and Big Sandy River (Upper Big Sandy River) for these constituents require standard water sample collection methodology and sample analysis by a certified laboratory. If routine monitoring of these reaches is to be conducted, sample collection and analysis must be consistent with data collection by the ADEQ to support the (305) b Assessment Report.

Following the example of the project outlined in Table 8-2, 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/ 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 or classified all twenty-one 10-digit HUC subwatersheds within the Bill Williams River Watershed for vulnerability to water quality degradation from nonpoint source pollutants (Section 6 and Table 8-1). This ranking was based on Arizona’s Integrated 305(b) Water Quality Assessment and 303(d) Listing Report, for the Bill Williams River Watershed (ADEQ, 2002).

In addition to the subwatershed classifications, this plan contains information on the natural resources and socio-economic characteristics of the watershed (Sections 2 through 5). Based on the results of the Classification in Section 6, example best management practices and water quality improvement projects to reduce nonpoint source pollutants are also provided (Section 7).

The subwatershed rankings were determined for the four major constituent groups (metals, sediment, organics and selenium) using fuzzy logic (see Section 6 for more information on this methodology and the classification procedure). The final results are summarized in this section and are shown in Table 8-1. In addition, technical and financial assistance to implement the stakeholder-group local watershed-based plans are outlined in this section.

Of the 21 subwatersheds included in this assessment, the three watersheds
with the highest risk of water quality degradation are:

1. Upper Big Sandy River Subwatershed, for metals pollution;

2. Kirkland Creek Subwatershed, for sediment pollution and for pollutants due to organics and nutrients derived from land use; and,

3. Castaneda Wash – Bill Williams River, for selenium due to agricultural practices.

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.

References:


http://www.dpla.water.ca.gov/agriculture/drainage