DEVELOPING A METHODOLOGY FOR IDENTIFYING AND PRIORITIZING AT-RISK WATER RESOURCES FOR THE COCONINO PLATEAU: COCONINO PLATEAU AT-RISK WATERS PROJECT FINAL REPORT

(ARIZONA WATER INSTITUTE PROJECT NO. 08-48)

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INTRODUCTION

The Coconino Plateau in northern Arizona supports a wide array of water resources, including aquifers, springs, streams, natural and anthropogenic ponds and reservoirs, including a portion of Lake Powell, the nation's second largest reservoir. The regional climate is continental and arid (Sellers et al. 1985), and the limited precipitation is bimodal (i.e., winter and summer storms). The region is dominated by mid-elevation desert shrubland and woodlands, with <10% forest, <2% open water, and <1% wetland-riparian habitat. Desert conditions place a premium on water availability, and hence many natural and even some anthropogenic water sources are highly valued, overdrawn, or the subject of much legal and policy discussion.

Prioritizing environmental needs for sustainable water use is a strategic plan element of the Coconino Plateau Water Advisory Council (CPWAC). To address that need, the Council desired a methodology to identify and assess waters that may be "at-risk" from climate change, land management changes, or surface water or groundwater use changes. A one-year project was proposed by CPWAC and funded in part by the Arizona Water Institute to engage a committee to: 1) develop draft assessment protocols to determine, compare, and prioritize the status of at-risk water resources on the Coconino Plateau; 2) develop a preliminary list of at-risk waters; 3) convene a workshop of experts to discuss the assessment protocols and test them using the proposed methods; 4) use the workshop results and relevant information to refine the assessment methods; and 5) use the proposed methods to conduct a pilot analysis of several representative types of water-related resources. These objectives are described further in this report. Interested entities can use the protocols presented here to conduct broad-scale assessment of the region's at-risk waters.

THE AT-RISK WATER PROJECT CORE TEAM

This effort was overseen by a Project Core Team (Team) comprised of governmental, academic, and conservation water resource experts and consisting of a sub-group of the CPWAC Technical Advisory Committee. The Project Lead was Abe Springer, hydrogeologist, NAU; the lead researcher was Larry Stevens, ecologist, NAU adjunct and Curator of Ecology, Museum of Northern Arizona; the team coordinator was Sue Pratt, Coconino County and Coconino Plateau Water Advisory Council. Other members of the Team included: Donald Bills, U.S. Geological Survey, Flagstaff; Chris Brown, Northern Arizona University; Jeanmarie Haney, The Nature Conservancy; Shaula Hedwall, U.S. Fish and Wildlife Service; Brad Hill, City of Flagstaff; James Hogan, SAHRA, University of Arizona; Mark Manone, GeoSpatial Research and Information Laboratory (GRAIL) Coordinator, NAU.

The Team met monthly to define the spatial scope of the project, develop draft value and risk assessment protocols, develop a list of invitees, and plan and implement the symposium. Team meetings were held monthly in Flagstaff, Arizona or via conference calls. Meeting agendas and minutes are appended to this report (Appendix A.).

PROJECT SCOPE

The Team discussed in detail the spatial scope of the project. Mr. Mark Manone of Northern Arizona University developed a geographic information map (GIS) of the project area, including the county, lands that provide runoff or groundwater flow into the county, as well as all named springs, streams, ponds, reservoirs, and other water resources (Figs. 1 and 2). The GIS map included layers of topography, water resource distribution, and land ownership. The Team debated the spatial scope of the project at length, and concluded that protection of Coconino County water resources required inclusion of groundwater and surface-water drainage basins that arose outside the County borders. Therefore, the map includes adjacent lands that contribute surface or groundwater flow to the County.

SYMPOSIUM

Introduction

The symposium was convened on 30 April and 1 May at the Museum of Northern Arizona (MNA) in Flagstaff. It brought together a wide array of local, Tribal, and state experts on Coconino Plateau water resources to collaboratively develop assessment protocols, identify the significant water resources within the identified project area, and attempt to score the prioritized sites using the scoring criteria. A total of 44 people attended the symposium; the list of invited and participating individuals is provided with this final report (Appendix C).

The assembled experts were provided with the draft assessment criteria prior to the meeting, and on the first evening were escorted to Coyote Springs on the MNA grounds to discuss and apply the criteria and scoring process in a hands-on exercise. After 1.5 hr, the group returned to the MNA auditorium for a discussion of their first efforts and a preview of the following day's agenda (Appendix A).

The symposium re-convened on 1 May 2008. The group was welcomed by Dr. Larry Stevens MNA's Curator of Ecology and Conservation on behalf of Museum Director, Dr. Robert Breunig. Ms. Liz Archuleta, Chair of the Coconino Plateau Water Advisory Council and Coconino County Supervisor, welcomed the symposium participants on behalf of the Coconino Plateau Watershed Advisory Council (CPWAC). Dr. Abe Springer provided an overview of the Arizona Water Institute (AWI), the AWI funded project which was supporting the workshop, existing water supplies for the region, potential future supplies of water for the region, and the ecological flow needs assessment process (Appendix D).

Discussion of Assessment Strategy

Site Scoring and Criteria Overview: The Team collaboratively developed a draft protocol for assessing sites, based on integration of a process developed by L. Stevens and collaborators in the Arizona Water Institute's Arizona Heritage Waters project of 2007-2008 (Appendix E) and The Nature Conservancy's Conservation Action Planning Process.

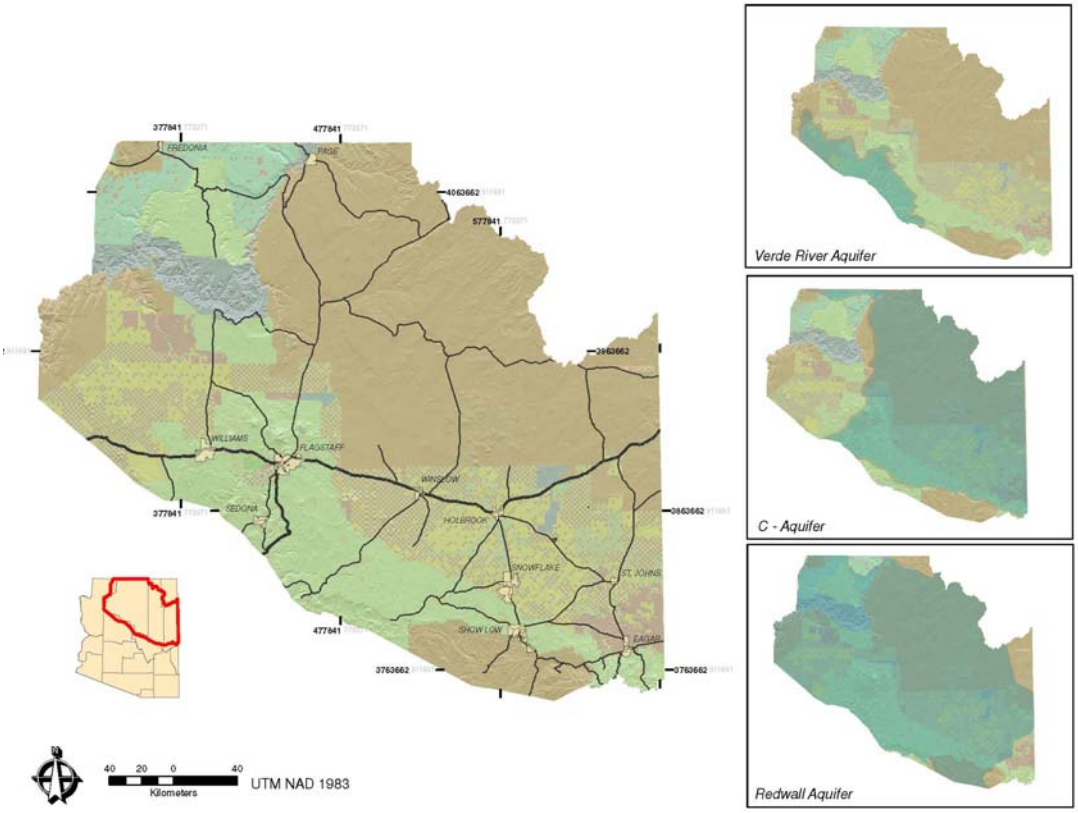

Fig. 1: Map of the study area and adjacent lands with inset of aquifers where scoring criteria was tested (prepared by M. Manone, NAU GRAIL Project).

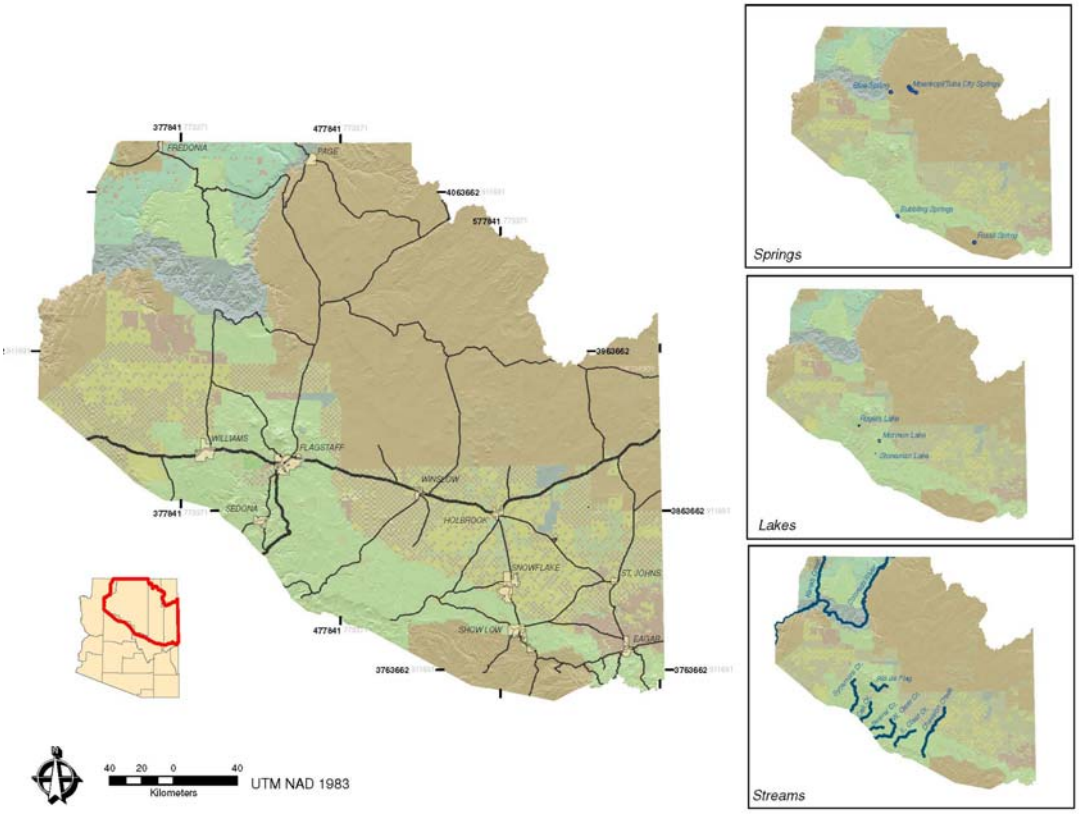

Fig. 2: Map of the study area and adjacent lands with inset of springs, standing water bodies, and streams where scoring criteria was tested (prepared by M. Manone, NAU GRAIL Project).

The protocol involved scoring sites for value of the resource and risk to the resource. Value and risk were quantified by applying scoring criteria to subcategories in each of seven (7) categories. The scoring criteria ranged from 0 (no value, low risk) to 6 (highest value, most at risk). Scores for each subcategory were rolled up for a composite percent score, and category and overall site scores were calculated as the percent possible score, ignoring missing values. This provides a means of assigning sites to a Value-Risk matrix. Those sites with both high value and high risk may justifiably be identified as locations most urgently in need action. Categories and subcategories are shown in Table 1. Ranking criteria are shown in Table 2.

Dr. Stevens reviewed the value and risk scoring criteria concept with the experts assembled at the symposium and asked that they evaluate the approach. Finding concurrence on the general value and risk identification approach, the participants were subdivided into working groups first on the basis of expertise in relation to the water resource types and scoring categories. The breakout groups re-evaluated the related categories, and the associated subcategories and scoring criteria, as well as the water resource types (Table 1). This process required more time than anticipated for legal, socioeconomic, and political categories because of the great complexity of these issues and the difficulty in quantifying these on all but a case-by-case basis, but all break-out groups were able to complete their review of the subcategories and scoring criteria (Table 2). That review provided the following refinement and considerations of the target water resources, which include: aquifers, springs, streams, and standing waters.

Breakout Group Discussion of Water Resource Types

Aquifers: The cultural breakout group questioned how many of the scoring criteria applied to aquifers, and recommended several modifications to the subcategories and scoring criteria. The group also questioned the nature of interconnectedness of aquifers and traditional cultures, a connectedness vectored by the springs and streams emerging from those aquifers, and whether complex, stacked aquifers conferred greater cultural value. The resolution of these issues may help focus attention on the relationship between aquifers and cultural values. They concluded that aquifer size and climate responses remain significant, but poorly understood, issues that are critical to understanding risks to aquifers.

Springs: This breakout group asserted that assessment of springs requires detailed information and great familiarity with the site. For this exercise, the group recognized that it was inappropriate to have individuals scoring a site with which they were not intimately familiar. Therefore, springs assessment should be conducted by a trained team, so that topics (e.g., aquatic insect diversity) could be handled as easily as possible in the field. The breakout group felt that more individuals would improve scoring, particularly of sensitive sites. Nonetheless, the group was concerned about the time-intensity (and potential cost) of Level II springs assessments: such assessments typically cost $1500-$4000. Consequently, prioritization of sites is required. The breakout group strongly recommended clarifying the scoring criteria definitions. For example, there was uncertainty as to what “physical” data included.

Table 1: Revised Coconino County At-risk Waters scoring and assessment sheet.

Coconino County At-Risk Waters Candidate Site Scoring Sheet					
Site Name:					
Site Number (if any):			**General / Regional Risks**	**Risk Score**	**Comments**
Location:			Climate Change/Drought		
Land Ownership:			Land Use/Land Cover Change		
Legal Status:			Groundwater Development		
Proposer:			Surface Water Resources Devel.		
Assessment Preparers			Water Quality		
Assessment Date:			Contamination		
Overall Site Score			**Regional Risk Score**		
Overall Site Risk Score			**Percent Missing Cells**		
Comments:					

Condition & Value and Risk Ranking:	**0 - none, 1 - very low, 2 - low, 3 - moderate, 4 - moderately high, 5 - high, 6 – exceptional**				
Category	**Subcategory**	**Value Score**	**Condition & Value Comments**	**Risk Score**	**Risk Comments**
Physical System	Hydrology				
Physical System	Geology/Geomorphology				
Physical System	Water Chemistry/Quality				
Physical System	Meteorology/Climate				
Physical System	Information and Understanding				
Physical System	**All Subcategories**				

Ecosystem / Habitat	Ecosystem (Aquatic-Terrestrial) Integrity				
Ecosystem / Habitat	Ecosystem Uniqueness				
Ecosystem / Habitat	Ecosystem Complexity				
Ecosystem / Habitat	Patch Dynamics*				
Ecosystem / Habitat	Rare, Endemic, ESA Listed Species				
Ecosystem / Habitat	Abundance of Native vs. Non-native spp.				
Ecosystem / Habitat	Impact of Non-Native Species				
Ecosystem / Habitat	Information and Understanding				
Ecology / Ecosystem Score	**All Subcategories**				
Native American Cultural	Ethnobiology				
Native American Cultural	Site Sacredness				
Native American Cultural	Trad. Cultural Property				
Native American Cultural	Education				
Native American Cultural	Information and Understanding				
Native American Cultural Score	**All Subcategories**				
Historical	Exploration History				
Historical	Settlement History				
Historical	Contemporary History				
Historical	Science History				
Historical	Education Potential				
Historical	Information and Understanding				
Historical Score	**All Subcategories**				
Socioeconomics	Recreation				
Socioeconomics	Water supply				
Socioeconomics	Water quality				
Socioeconomics	Information and Understanding				
Socioeconomics Score	**All Subcategories**				
Other Criterion 1					

Other Criterion 2					
Other Criterion 3					
Other Score	**All Subcategories**				
Overall Score	**All Subcategories**				
Uncertainty Count	**Number of Missing Cells**				
Uncertainty Percent	**Percent of Missing Cells**				

Note: If "Other" category is used, adjust overall values and risk score equations.
*Habitat patch dynamics includes patch size, isolation, patch connectivity, etc.

Table 2: Revised Coconino County At-risk Waters scoring criteria.

Category	Subcategory	Resource Condition and Risk Score						
		0	1	2	3	4	5	6
Physical System	Hydrology	None	Very low	Low	Moderate	Moderately high	Very high	Maximum
Physical System	Geology/Geomorphology	None	Very low	Low	Moderate	Moderately high	Very high	Maximum
Physical System	Water Chemistry/Quality	None	Very low	Low	Moderate	Moderately high	Very high	Maximum
Physical System	Meteorology/Climate	None	Very low	Low	Moderate	Moderately high	Very high	Maximum
Physical System	Information and Understanding	None	Very low	Low	Moderate	Moderately high	Very high	Maximum
Ecosystem / Habitat	Ecosystem (Aquatic-Terrestrial) Integrity	None	Very poor	Poor	Fair	Good	Very good	Excellent (pristine)
Ecosystem / Habitat	Ecosystem Uniqueness	None	Very common	Common	Unusual	Rare	Very rare	Exceptionally rare
Ecosystem / Habitat	Ecological Complexity	None	Very low complexity	Low complexity	Moderate complexity	Complex, not exceptional	Highly complex, highly interactive	Excellent
Ecosystem / Habitat	Habitat Patch Connectivity	Patch issues eliminated	None	Slight connectivity	Moderate connectivity	Moderately high connectivity	Very good connectivity	Complete connectivity
Ecosystem / Habitat	Rare, Endemic, ESA Listed Species	None	Formerly occurred but no longer present	Possibly 1 species	At least one	Several (2-3) species	Quite a few (4-6) species	Many (>6)

Ecosystem / Habitat	Abundance of Native vs Non-native spp.	None	Very low (1-10%)	Few (10-33%)	Moderate(33-67%)	Good (67-95%)	Very good (95-99%)	All (>99%)
Ecosystem / Habitat	Absence of Non-native Species Impacts	None	Very low (1-10%)	Low (10-33%)	Moderate (33-67%)	Fairly high (67-95%)	Very high (95-99%)	Virtually none (>99%)
Ecosystem / Habitat	Information and Understanding	None	Very little	Little	Moderate	Good	Much	Exceptional
Native American Cultural	Ethnobiology	None	Very little	Unimportant	Moderately important	Important	Very important	Critically important
Native American Cultural	Site Sacredness	None	Very little	Little	Moderate	Good	Much	Excellent
Native American Cultural	Trad. Cultural Property	None	Very little	Unimportant	Moderately important	Important	Very important	Critically important
Native American Cultural	Education	None	Very little	Unimportant	Moderately important	Important	Very important	Outstanding
Native American Cultural	Information and Understanding	None	Very low	Low	Moderate	Moderately high	Very high	Maximum
Historical	Exploration History	None	Very little	Little	Moderate	Good	Much	Exceptional
Historical	Settlement History	None	Very little	Little	Moderate	Good	Much	Exceptional
Historical	Contemporary History	None	Very little	Little	Moderate	Good	Much	Exceptional
Historical	Science History	None	Very little	Little	Moderate	Good	Much	Exceptional
Historical	Education Potential	None	Very little	Little	Moderate	Good	Very good	Outstanding
Historical	Information and Understanding	None	Very low	Low	Moderate	Moderately high	Very high	Maximum
Socioeconomics	Recreation	None, eliminated	Very low	Low	Moderate	Good	Very good	Excellent

Socioeconomics	Water supply	None, eliminated	Very unsustainable	Very limited supply	Moderate supply	Good supply	Very good	Abundant supply
Socioeconomics	Water quality	None, eliminated	Very poor	Poor	Moderate	Good	Very good	Excellent
Socioeconomics	Information and Understanding	None	Very little	Little	Moderate	Good	Much	Exceptional
Other	Other	None	Very little	Little	Moderate	Good	Much	Exceptional

Streams: The lotic waters breakout group felt that it was important to separate Oak Creek from other streams in the region. The upper section of Oak Creek is a gaining stream, while other streams and segments of this drainage and other streams in the county are losing reaches. Also, a bewildering array of anthropogenic impacts and issues confront sustainable management of Oak Creek. The breakout group also recommended moving the subcategory of hydrology to the science realm. Furthermore, to distinguish the impacts of effluent, the group felt it was important to distinguish between streams with flow dominated by surface runoff, spring-fed baseflow, and dominance by effluence.

Standing Waters: Lakes were difficult to evaluate as separate from water sources because of their rarity and the limited understanding of the ecology of ephemeral, high elevation lakes. Although Coconino County has numerous natural ponds at elevations above 8,000 ft, innumerable earthen stock tanks, and many reservoirs, the county contains few bodies of water that can be considered lakes. Only Stoneman and Mormon "Lakes" are thus regarded, and both are ephemeral, desiccating wholly in dry years. The ephemeral nature of those water bodies greatly influences the scoring procedure, but there is little ecological understanding of the natural functioning of such large, ephemeral water bodies, and the best management practices for them. This is an area of needed research.

Breakout Group Discussion of Scoring Categories and Criteria

General Comments: Category scoring was designed so that information that was unknown about individual subcategories did not preclude assessment based on known information. A comments column is provided to reference the source of the value and risk information. The breakout groups considerably rearranged the categories and subcategories (Table 1), and made numerous suggestions to the scoring criteria (Table 2). These comments were incorporated into the draft scoring design (Appendix E) during the meeting and used to facilitate afternoon prioritization of several representative nominated sites.

Physical Variables Category Break-out Group: Originally proposed as components of numerous categories, including scientific information, five physical variables associated with a site were selected. These now include: 1) hydrology, 2) geology/geomorphology, 3) water chemistry and quality, 4) meteorology and climate, and 5) information and understanding. The break-out group simplified the number of physical variables and clarified which physical variables are most important to value and risk definition. Scoring criteria for these subcategories are described in Table 2.

Ecosystem / Habitat Break-out Group: Ecosystem integrity is an important component of water resource integrity, and was originally proposed as two categories – ecology and habitat. This group debated several issues:

- Lakes are more difficult to evaluate and should be distinguished as a separate type of at-risk water within the project area.
- It helps to be familiar with a springs ecosystem prior to scoring, as it takes several hours to go through a single site.

- Scoring definitions need to be more clear, and expertise of the assessment team is essential.
- Streams – it is important to distinguish among reaches as management units. For example, Oak Creek consists of gaining and losing reaches, which have very different risks. Baseflow, and the dominance of effluence and runoff, are strongly influential factors affecting stream reach ecology and designation.
- Hydrology needs to be included as a scientific subcategory in the physical category.
- Aquifers: What is the interconnectedness of aquifers with indigenous culture?
- Values and risks vary between strata in stacked aquifers.
- Risk varies by size of aquifer and climate change.

The break-out group condensed the originally proposed ecosystem and habitat categories into a total of eight variables: 1) aquatic and terrestrial ecosystem integrity, 2) ecosystem uniqueness, 3) ecosystem complexity, 4) habitat patch dynamics, 5) the number of sensitive species, 6) the abundance of native versus non-native species, 7) impact of non-native species, and 8) the quality of information and understanding of ecosystem and habitat conditions. The role of non-native species is thus addressed in two subcategories, and the associated comments fields can be used to clarify the condition and risks to site resources related to the impacts of non-native species. Scoring criteria for these subcategories are included in Table 2.

Native American Cultural Variables Category: Commentary on this section involved several topics. All places where natural water exists or has existed are regarded by Native American Tribes as highest priority, a category "6" and are identified irreplaceable cultural resources; however, subsequent discussions with several tribal participants revealed that because of the multifaceted nature of cultural values (education, religious, ethnobiological economics, education), sufficient variation in cultural scores may be generated to clarify sites with differing overall cultural value. Nonetheless, all water projects affecting Tribal lands require federal consultation, and the Tribes decide individually whether and to what extent to list a site as sensitive. If multiple Tribes claim water resource they are all consulted and the highest rating is the one proposed to be used.

The cultural category was condensed and now includes: 1) ethnobiology, 2) site sacredness (recognized as a complex variable), 3) traditional cultural property, 4) education, including sites used for cultural educational training, and 5) quality of information and understanding. Scoring criteria for these subcategories are described in Table 2.

Historical Variables Category: This topic was included in discussions by the cultural break-out group, and was essentially unchanged. The category was recognized as important, and that historical information and resources may be valued and threatened as are other site variables. The historical category includes six variables, including: 1) exploration history, 2) settlement history, 3) contemporary history, 4) science history, 5) education potential, and 6) information and understanding. Scoring criteria for these subcategories are described in Table 2.

Socioeconomic Variables Category: The legal and socioeconomic break-out group considered the proposed issues in considerable depth, concluding that only four variables could be resolved in this kind of rapid assessment. The four variables identified include: 1) recreational socioeconomics, 2) water supply, 3) water quality, 4) information and understanding about socioeconomic issues associated with a site. Scoring criteria for these subcategories are described in Table 2.

Site Nomination and Prioritization

A site nomination process was led by Dr. Abe Springer. A total of 91 sites were nominated at the workshop within four natural hydrologic resource categories that had been discussed by the Team; aquifers, springs, streams, and standing water bodies (Table 3). The list in Table 3 is not comprehensive and only reflects the comments received during the workshop. A more comprehensive list of sites is included in Appendix B of the report, a digital geographic information system of the region. A complete, comprehensive list of at risk sites was not an objective of the project and would require a separate project. After the 91 sites were listed, the symposium attendees then voted for three sites within each site type that they considered the highest priority sites.

Scores from the voting were tallied, and the sites with the highest scores were considered for testing the evaluation process during the subsequent period in the symposium (in italics in Table 3). The aquifer sites included: the Verde River basin aquifer (consolidated), and the consolidated and unconsolidated Coconino Plateau basin aquifers. The springs sites included: Fossil, Blue, Bubbling, and the Tuba City/Moenkopi area springs. The prioritized streams included: the largest Middle Verde basin streams (Sycamore, Oak, Beaver, and West Clear Creeks), the Colorado River in Grand Canyon, East Clear Creek and its tributaries, the Rio de Flag, and Kanab Creek. Not surprisingly, the highest priority standing waters included the largest lake-like bodies of water in the county: Mormon, Stoneman, and Rogers Lakes. Workshop attendees brainstormed potential sites within the four categories of types of sites.

Test Scoring of Priority Sites

During the afternoon session of the symposium, the attendees were reorganized by expertise to test the revised scoring system on a small number of draft prioritized aquifers, springs, streams, and standing waters (Table 4, Appendix E). Due to time constraints, not all sites could be evaluated by the breakout groups. For example, due the complexity of springs sites, that break-out group was only able to assess one site during the symposium. Consequently, not all of the highest priority sites for each water resource type have been scored in Table 3 and Appendix E. Additional information was added to the scoring sheets for some of the high priority sites by Core Team members through consultation of the scientific literature (information that was not readily available at the symposium), and by conducting site visits following the symposium. This information is added in italics in Table 3 and Appendix E, and helped improve the scoring of subcategories and categories.

Graphical depiction of site value versus risk scores is one output of this assessment process (Fig. 3). This graph demonstrates considerable variation in value and risks among the water resources considered by the symposium participants.

Although considering only 12 of the 91 sites nominated by the symposium participants and the many other at-risk waters not yet considered, the graph indicates

Table 3: Scoring summary of potential Coconino Plateau At-Risk sites by type, land management authority, and voting score. Bold, italic font indicates priority sites evaluated during the project by workshop participants and core team with results in Table 4 and Figure 2.

Site Name	Site type	Land Management	Vote Score
Verde River Basin aquifer - consolidated	***Aquifer***	***Numerous***	***18.00***
Coconino Plateau Basin aquifer - consolidated	***Aquifer***	***Numerous***	***16.00***
Coconino Plateau Basin aquifer - unconsolidated	***Aquifer***	***Numerous***	***9.00***
Little Colorado River Basin aquifer - consolidated	Aquifer	Numerous	9.00
Verde River Basin aquifer - unconsolidated	Aquifer	Numerous	5.00
Kanab Plateau Basin aquifer - consolidated	Aquifer	Numerous	4.00
Little Colorado River Basin aquifer - unconsolidated	Aquifer	Numerous	1.00
Kanab Plateau Basin aquifer - unconsolidated	Aquifer	Numerous	0.00
Peach Springs Basin aquifer - consolidated	Aquifer	Numerous	0.00
Peach Springs Basin aquifer - unconsolidated	Aquifer	Numerous	0.00
Fossil Springs	***Spring***	***Coconino National Forest***	***9.00***
Blue Springs	***Spring***	***Navajo Tribe***	***8.00***
Bubbling Springs	***Spring***	***Arizona Game and Fish***	***7.00***
Tuba City/Moenkopi area springs	***Spring***	***Navajo and Hopi Tribes***	***7.00***
Coyote Spring	Spring	MNA	5.00
Montezuma's Well	Spring	Montezuma Castle National Monument	5.00
Havasu Springs	Spring	Havasupai Indian Tribe	4.00
South Rim springs	Spring	Grand Canyon National Park	4.00
Hart Prairie	Spring	The Nature Conservancy	3.00
Thunder River Spring	Spring	Grand Canyon National Park	3.00

Griffith Spring	Spring	Coconino National Forest?	2.00
Page Springs	Spring	Arizona Game and Fish	2.00
South Canyon Spring	Spring	Kaibab National Forest	2.00
Hopi Salt Mines	Spring	Grand Canyon National Park	1.00
Hoxworth Spring	Spring	Coconino National Forest	1.00
Hugo Meadows	Spring	Arizona Game and Fish	1.00
North Canyon Spring & North Canyon	Spring	Kaibab National Forest	1.00
Old Town Springs	Spring	City of Flagstaff	1.00
Silver Creek Spring	Spring	Arizona Game and Fish	1.00
Sipapu	Spring	Navajo Tribe	1.00
Ashurst Springs	Spring	Coconino National Forest	0.00
Big Springs	Spring	Kaibab National Forest	0.00
Buck Springs	Spring	Coconino National Forest	0.00
Fence Fault springs	Spring	NPS and Navajo	0.00
Lindberg Spring	Spring	Coconino Nat'l. Forest?	0.00
Porter Springs	Spring	Private	0.00
San Francisco Peaks springs	Spring	Coconino National Forest	0.00
Sterling Spring	Spring	Coconino National Forest	0.00
Vaseys Paradise	Spring	Grand Canyon National Park	0.00
Mormon Lake	***Standing***	***Coconino National Forest***	***16.00***
Stoneman Lake	***Standing***	***Coconino National Forest and private***	***10.00***
Rogers Lake	***Standing***	***Arizona State Land Department and Private***	***6.00***
Marshall Lake	Standing	Coconino National Forest	5.00
Lower Lake Mary	Standing	Coconino National Forest/City of Flagstaff	4.00
Upper Lake Mary	Standing	Coconino National Forest/City of Flagstaff	4.00
Lyman Lake	Standing	Arizona State Parks	3.00
Pasture Canyon	Standing	Hopi Tribe	2.00
CC Cragin (Blue Ridge Reservoir)	Standing	Coconino National Forest, Salt River Project, and Bureau of Reclamation	1.00
Dogtown	Standing	City of Williams	1.00
Laguna	Standing	Hualapai Tribe	1.00
Cataract	Standing	City of Williams	0.00
Davenport	Standing	Kaibab National Forest	0.00
Dog Knob	Standing	Kaibab National Forest	0.00

Gonzales	Standing	Private	0.00
Hay Lake	Standing	Coconino National Forest	0.00
Kaibab	Standing	City of Williams	0.00
Long Point	Standing	Arizona State Land Department	0.00
Red Lake Tank	Standing	Kaibab National Forest	0.00
Smoot	Standing	Private	0.00
Stone	Standing	Kaibab National Forest	0.00
Tule	Standing	Havasupai Indian Tribe	0.00
Turkey Tanks	Standing	Coconino National Forest	0.00
Sycamore, Oak, Beaver, West Clear Creeks	***Stream***	***Coconino National Forest ,Private, Arizona State Land Department, National Park Service, Arizona Game and Fish Department, Prescott National Forest***	***8.00***
Chevelon Creek	***Stream***	***ASNF, Private, State***	***8.00***
Colorado River - Grand Canyon	***Stream***	***AZ State and Grand Canyon National Park***	***7.00***
East Clear Creek & Tribs	***Stream***	***Coconino National Forest***	***7.00***
Rio de Flag - Picture Canyon	***Stream***	***Arizona State Land Department***	***7.00***
Kanab Creek	***Stream***	***Grand Canyon National Park, Bureau Land Management***	***6.00***
Little Colorado River	Stream	Navajo Tribe	5.00
Moenkopi Wash	Stream	Navajo and Hopi Tribes	3.00
Silver Creek	Stream	Private, AZ State Land Department	2.00
Upper LCR Tributaries	Stream	Numerous	2.00
Bright Angel Creek	Stream	Grand Canyon National Park	2.00
Grand Falls	Stream	Navajo Tribe	1.00
Havasu Creek	Stream	Havasupai Tribe, GCNP	1.00
Rio de Flag - Logan's Crossing	Stream	Coconino National Forest	1.00
Rio de Flag - Narrows	Stream	City of Flagstaff	1.00
Shinmu Creek	Stream	Grand Canyon National Park	1.00
Wepo Wash	Stream	Unknown	1.00
Cataract Canyon - Markham Dam	Stream	Babbitt Ranches?	0.00
Colorado River - Glen Canyon	Stream	National Park Service	0.00
Colorado River - Lees Ferry	Stream	Glen Canyon NRA	0.00
Colorado River - Marble Canyon	Stream	Grand Canyon National Park	0.00
Dinnebeto Wash	Stream	Navajo Tribe	0.00

Jadito Wash	Stream	Navajo Tribe	0.00
Navajo Creek	Stream	Navajo Tribe	0.00
Oraibi Wash	Stream	Hopi Tribe	0.00
Polacca Wash	Stream	Hopi Tribe?	0.00
Sinclair Wash	Stream	Arizona State Land Department, Private	0.00
Skunk Canyon	Stream	Coconino National Forest	0.00
Walnut Canyon	Stream	Walnut Canyon National Monument, Coconino National Forest	0.00

Table 4: Example application of site condition & value scores at the 12 At-risk Water resources evaluated by the symposium participants and core team. Note, these scores are just a practice exercise and may change when an interdisciplinary team of experts evaluates the values and risks. The scores may not accurately represent the actual values or risks of these sites and are subject to revision. . Blank cells were not scored at the symposium and are not included in the overall site scores.

			Category score							
Site	Water Resource Type	Value or Risk	Physical	Ecosystem - Habitat	Native American Culture	Historical	Socioeconomics	Other Score	Regional Risk	Overall Site Value or Risk Score
Coconino Plateau Consolidated	Aquifer	Value	77	---	75	44	67	---	---	64.0
Coconino Plateau Consolidated	Aquifer	Risk	50	38	83	50	75	---	56	59.2
Coconino Plateau Unconsolidated	Aquifer	Value	75	48	67	38	56	---	---	55.2
Coconino Plateau Unconsolidated	Aquifer	Risk	57	44	89	50	75	---	58	59.5
Verde Basin	Aquifer	Value	70	83	100	44	71	---	---	69.4
Verde Basin	Aquifer	Risk	47	77	100	50	77	---	78	64.9
Blue Springs – LCR	Springs	Value	33	54	---	28	29	---	50	38.4
Blue Springs – LCR	Springs	Risk	73	71	---	50	71	---	---	65.9
Coyote Springs	Springs	Value	67	70	67	75	60	---	---	67.6
Coyote Springs	Springs	Risk	68	73	47	20	57	---	---	53.0
Fossil Springs	Springs	Value	83	88	94	86	83	---	---	86.5
Fossil Springs	Springs	Risk	23	54	44	39	33	---	69	40.4
Rogers Lake	Standikng	Risk	54	75	---	---	---	0	53	67.9
Mormon Lake	Standing	Value	60	81	---	56	50	---	---	65.8
Mormon Lake	Standing	Risk	50	58	---	56	50	---	61	53.6
Rogers Lake	Standing	Value	60	71	---	---	---	---	---	66.7
Stoneman Lake	Standing	Value	---	42	---	44	54	---	---	45.4
Stoneman Lake	Standing	Risk	54	54	---	50	44	---	39	50.8
Colorado River in Grand Canyon	Stream	Value	70	71	---	86	100	---	---	79.7
Colorado River in Grand Canyon	Stream	Risk	47	63	---	17	38	---	69	42.8
Middle Verde Tribs.	Stream	Value	87	81	94	94	94	---	---	86.1
Middle Verde Tribs.	Stream	Risk	71	81	67	17	78	---	67	70.0
Picture Canyon	Stream	Value	43	58	79	64	46	---	---	58.0
Picture Canyon	Stream	Risk	63	58	71	33	67	---	72	56.8

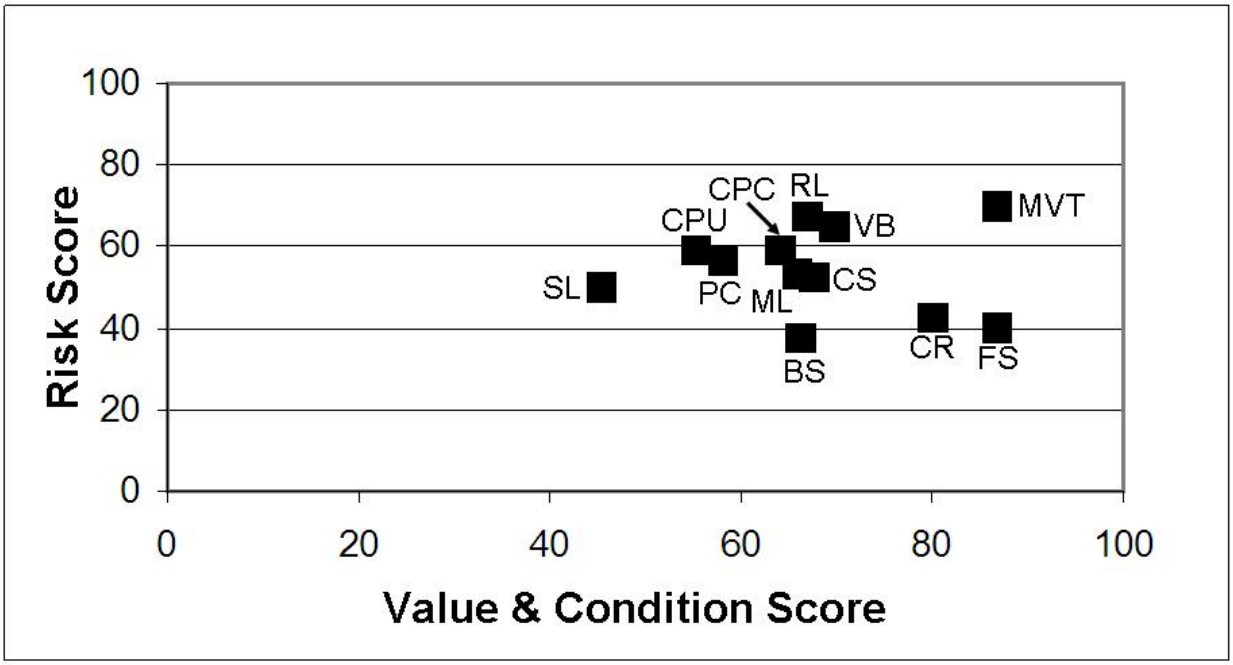

Fig. 3: Example application of site condition & value score against risk among 12 At-risk Water resources evaluated by the symposium participants and core team. These scores are a practice exercise and may change when an interdisciplinary team of experts evaluates the values and risks, so they may not accurately represent the actual values or risks of these sites. Sites: BS–Blue Springs, CPC–Coconino Plateau consolidated aquifer, CPU–Coconino Plateau unconsolidated aquifer, CR–Colorado River, CS–Coyote Springs (MNA campus), FS–Fossil Springs, ML–Mormon Lake, MVT–Middle Verde tributaries, PC–Picture Canyon, RL–Rogers Lake, SL- Stoneman Lake, VB–Verde Basin aquifer. Values are derived from Table 4.

that resources such as the Verde River basin aquifer and tributaries are of high value and are potentially at high risk. Aquifers, springs, and streams appear to be more highly valued than are standing bodies of water, but that is largely an artifact of inadequate expertise among the scoring panels on the values, ecological functions, and risks associated with those resources. Also, streams may be somewhat more valued than individual springs, which may be somewhat related to habitat patch size.

The test exercise of scoring the values and risks of sites also indicated the importance of having an interdisciplinary team of experts conduct the evaluations. A

team should be trained on the techniques of the scoring and should conduct a "normalization" exercise by scoring a common site where most information is commonly know, such as the evaluation of Coyote Springs as part of this project. This prevents some categories being unscored, and potentially influencing the overall score of a site. Because the criteria to score are subjective, the interdisciplinary team and their subsequent training are important components of a successful and consistent application of the approach recommended in this project.

CONCLUSIONS

The collaboratively-derived site identification and value-risk scoring processes were generally supported by the participants, and provide a consensus-based approach for prioritizing at-risk waters and informing stewardship decision-making on the Coconino Plateau. Completing the assessment protocol for the list of "at-risk" waters will provide scientific and reality-based guidance for making strategic decisions related to sustainable water management on the Coconino Plateau. Scoring of some variables, such as cultural values and risks, requires consultation with cooperating Tribes and resource stewards, and therefore will require additional time. It is likely that Tribes would need to be provided resources to have adequate staff time to conduct such evaluations. Although the scoring of values and risks in this project was just a practice exercise for illustrative purposes and did not include a sufficient interdisciplinary team for full evaluation, contrasting the draft condition-value scores against the risk scores provided a clear depiction of which sites were both highly valued and are at elevated risk. This process promotes a broad consensus that makes water resource decision-making a more robust and socially equitable process. The methods described in this report provide a promising approach to comparative valuation and risk assessment of the County's water resources. When used by an interdisciplinary team of experts, this approach can identify and assess resource management priorities for the Coconino Plateau. Further refinement of the process is likely needed if the process is adopted by other counties in Arizona, but it should provide Coconino County, as well as other interested entities with improved and more socially responsible insight into water resource management needs and opportunities.

RECOMMENDATIONS

Based on the results of the Coconino Plateau At-Risk Waters Project, we make the following recommendations for next steps.

1) Identify stakeholders and resources which can complete the following recommendations.
2) Compile a comprehensive list of all at-risk water resources on the Coconino Plateau.
3) Assemble and train an interdisciplinary team and determine the values and risks of all at-risk water resources on the Coconino Plateau.
   The interdisciplinary team should be as small as possible, but include at least the following fields of expertise (no order of importance is implied)
   a) Groundwater hydrologist and geochemist,
   b) Biologist familiar with both springs flora and fauna,
   c) Cultural coordinator (to discuss and resolve tribal valuation issues),
   d) Historian,
   e) Resource compliance advisor-one who is familiar with the policies of state and federal agencies having jurisdiction over the water body and its associate resources,
   f) Legal advisor who is familiar with applicable local, state, and federal law, especially water law,
   g) Economist,
   h) Education advisor, and
   i) Involvement of the steward(s) of the water body under investigation.
   This list could be reduced somewhat, particularly if participants had more than one area of expertise.
4) Prioritize the aquifers, springs, streams, and standing water bodies on the Coconino Plateau by their values and risks.
5) Recommend to the Coconino Plateau Water Advisory Council which sites have the highest priority for conservation, management, mitigation, or restoration.

APPENDIX A:

COCONINO COUNTY AT-RISK WATERS PROJECT CORE TEAM MEETING MINUTES

1. Core Team Meeting for TAC/AWI At-Risk Water Resources Research Project January 23, 2008 9 a.m.-11-a.m. Thomas Auditorium, Coconino County Complex, 2500 N. Fort Valley Road, Flagstaff, Arizona

Present: Abe Springer, Larry Stephens, Mark Manone, Shaula Hedwall, Jeanmarie Haney, Sue Pratt, Brad Hill, James Hogan (phone)

MOU-
Abe has signed draft,

- **Need to finalize subcontract with MNA and NAU—Lynn from MNA will contact Beate at NAU**
- Abe wants to make sure we do a good job of record-keeping for in-kind contributions—sign-in sheets , etc.
- Abe reviewed the timeline for meetings, workshop, site visits after the workshop, and deliverables which will include an interim and final report, and a website.

Study Area
Include surface watersheds and groundwater basins that serve NCAWSS Demand Center
General boundaries: Kanab Creek to west, State line to north, follow LCR boundary east to New Mexico then LCR boundary to the south and back west to Diamond Rim Fault, include headwaters of Verde, and close with Aubrey fault to the west.

- **Mark will take discussion and put on map**

Workshop

- Larry will confirm availability of Brannigar Chase Center at MNA-target Wednesday April 30 for evening reception, full day workshop on Thursday, May 1. Backup plan would put it the week before
- Invitees-Larry will start list and send out
- Need to identify specific goal/purpose of workshop so attendees know what is expected.
- Abe suggested one norming site to be done by the core group in advance of workshop and then use it as a norming exercise at the workshop.
- Larry reviewed criteria list used for the Heritage Waters project-suggest nominating sites prior to workshop.
- James said that the risk aspect needs to come out strongly on the list.
- Suggestion for risk analysis expert to give literature overview for workshop (Larry suggested Dave Garrett)

Discussion of further information needed and possible information sources:

- Types of water data
- Cultural Features
- Demographics (any GIS data)
- F&W aquatic species
- TNC spreadsheet for threat analysis
- State and National Parks and Monument

Next meeting Tuesday, February 19 1 p.m. at the GRAIL Lab, room 226 of the ARD Building on NAU Campus.

2. Core Team Meeting for TAC/AWI At-Risk Water Resources Research Project February 19, 2008 GRAIL Lab Conference Room ARD Bldg-NAU, Flagstaff, Arizona

Present: Abe Springer, Mark Manone, Shaula Hedwall, Brad Hill, Sue Pratt, and Jeanmarie Haney and Dale Turner by phone.

Abe started the meeting by mentioning that the final MOU has been signed and we are now official.

Study Area

It was agreed to re-order the agenda and start with reviewing the map of the study area that Mark had prepared. Discussion about the boundaries, overlaying springs. Mark said that he has several data layers that can be overlayed but still needs some more, particularly related to the cultural sites and concerned about availability of that information. He has rivers, springs, watersheds, open waters, wetlands, and aquifers. Shaula will either get him the information from US Fish and Wildlife or he will obtain from Haydee. Mark confirmed that his map includes the waters that were included in Jeanmarie's map as being critical to be included in the study area, those being the surface waters that are affected by the C-aquifer. Abe said that the Diamond Rim Fault is the appropriate boundary for the study to include the areas of influence relative to the C-aquifer in that area.

- Need to get feedback from Larry and James on the map
- Need to identify additional information sources for any layers that are lacking

Workshop

The workshop is confirmed for Thursday May 1, with an introductory event Wednesday evening, April 30. The venue is the Museum of Northern Arizona Brannigar-Chase Auditorium. One possible conflict is the AWPC Meeting which is the same week.

Methodology

The appropriate methodology to achieve expected outcome was discussed. Dale thought there may be challenges to do priority-setting with so many categories.

Discussion of TNC conservation action-planning process which looks at potential sites, threats, and actions. Another method used by TNC is a Sequencing Conservation Action Tool.

- Dale will send out more information about the two methodologies TNC uses. Everyone will review the detailed information and we will continue the discussion via email.
- Think about all of the values we want to include (cultural, historical, etc.)
- Abe will follow-up with Larry on this discussion

Sites

There was discussion about whether we were trying to prioritize the waters, the risks, or waters that are at risk. Study is "Prioritize At-Risk Water Resources"

- Be as inclusive as possible
- Need to identify sites that are representative of sites that aren't currently on list
- Added sites-Kanab Creek, Silver Creek, Porter Springs, Buck Springs, Hay Lake
- Mark can make a layer for the map of all of the sites
- Be prepared (via email exchanges) to do a site assessment at our next meeting in March

Invitee List/Invitation

- Add AWI reps
- Add Dale Turner, TNC
- Add ADWR attorney rep
- Add NPS Flagstaff Area Monuments
- Add Board of Supervisors
- Make sure all WAC member agencies are included through TAC or other
- Shaula will send additional contact info for forest service and F&W
- Send out invitations March 1, request confirmations by March 28
- Workshop agenda and background materials will be sent April 15
- Send on CPWAC letterhead

Next Meeting: March 27 at USGS Building 3

3. **Core Team Meeting for TAC/AWI At-Risk Water Resources Research Project March 27, 2008 Museum of Northern Arizona, Flagstaff, Arizona**

Present: Abe Springer, Larry Stevens, Don Bills, Sue Pratt, Jeanmarie Haney, Chris Brown

Site Scoring
The group met at Coyote Springs on the Museum of Northern Arizona Grounds near The Peaks. Larry explained the significance of the site and the group discussed the revised site scoring work sheet.
Larry will make changes and get out to the group.

Study Area
Chris Brown, Abe's graduate student, will work with Mark on the map.

Refer any comments about the map to Chris

Workshop Agenda
The group discussed the workshop agenda and how the logistics would work. Sue reported that there hasn't been a huge response and that we will need to send out a reminder to invitees to RSVP.

Larry and Abe will prepared draft agenda, Larry will also prepare background text to be sent out to workshop participants in advance.

4. Core Team Meeting for TAC/AWI At-Risk Water Resources Research Project April 7, 2008—Conference Call
Present: Abe Springer, Larry Stevens, Don Bills, Sue Pratt, Shaula Hedwall, James Hogan, Mark Manone

Review of Revised Site Scoring Sheet and Criteria
Discussion about the apparent redundancy across the categories and how general risks were factored in. Abe noted that the workshop participants will have an opportunity to change and modify the criteria if deemed appropriate.

- Larry will get revised site scoring sheet and criteria to the group by Thursday.
- Set up at museum around 10 a.m. on Wednesday, April 30 for Mark and his high-tech gear.

Review of Draft Workshop Agenda
Wednesday—At Coyote Springs Larry will give a brief overview of the site characteristics prior to having participants divide into teams and do test scoring. Suggest that the scoring teams should be led by group leaders comprised of core team members to help guide through the process. Have sign-up sheet for additions to the site list at registration and throughout Thursday morning.

Thursday—
8:30-9:30 Mark and Chris will do the presentation of study area overview with maps

9:45-11:30 Discussion of process and breakout groups for session-suggest break out by scoring category and depending on how many participants, may decide to group

categories together (e.g. cultural/historical). Each group will spend half of their time discussing the Values and the other half on Risks, reconvene as full group for report back with recommended changes at 11:30-12.
During lunch someone will make revisions to the material for the afternoon session based on input from morning session. Have site list finalized before lunch.

- **Assignments for group leaders**
  - Cultural/Historical Kelly Hayes Gilpin-Larry will check her availability
  - Ecosystem/Habitat -Shaula
  - Information/Science - James
  - Legal/Politics/Socioeconomics - Kathy Jacobs

- Need to identify who will update materials during lunch
- Provide list of sites prior to lunch

Afternoon
Larry said the point of the afternoon sessions is to test what was developed in the morning, based on feedback from groups.

1:00-2:15 Have sites organized by type (spring, stream, aquifer, open water) and have full group will nominate top 3 sites by type. Breakout into groups based on these types which will then use the scoring sheet as revised by morning sessions.

Discussion of how voting will work-Mark will have excel spread sheet showing the sites, just vote by show of hands for overall most important sites by type. If there are only two or three sites in a type, probably won't need to vote. We will identify team leaders for site type breakout group during lunch (if not before).

- Sue will revise agenda based on discussion

Review of map of study area.
Colors-better differentiation in blues, distinguish different regions of aquifers-e.g. Grand Canyon South Rim and North Kaibab Plateau, include groundwater basins

- Don will get recommendation on aquifers for list to Sue and Abe
- Mark will have separate maps of the different types of water sources
- Mark will identify the sites that have been included on the list

Finalize background material to be distributed to Workshop Participants
Discussion of what to include: Cover letter outlining project and purpose of workshop, a more general map, site scoring criteria and sheet from Larry.

Update on Responses for Workshop Participants
Sue estimated about 30 so far, maybe we'll get 50 for workshop, some will come Wednesday, but not Thursday. Sue will send out one more reminder email and then

ask Core Team members to help follow up with people that haven't responded, particularly the ones we know would be good to have at the workshop.

- Sue will send out reminder email
- Sue will send out list to core team for help with follow-up phone calls

Set next meeting prior to workshop

- Next meeting, Thursday, April 24 8:30 a.m.-location to be determined.

5. Core Team Meeting
AWI CPWAC TAC Research Project
Coconino Plateau At-Risk Water Resources
Building 3 USGS Campus; 2255 N Gemini Drive, Flagstaff, Arizona
Thursday, April 24, 2008, 8:30 a.m.

In attendance: Abe Springer, Sue Pratt, Jeanmarie Haney, Mark Manone, Chris Brown, Don Bills, and Larry Stevens and James Hogan by phone

Finalize Workshop Agenda and Logistics

- Larry is setting up tables for 55, can reduce to 45 for caterers
- Mark is bringing equipment Wednesday a.m. to set up-will have maps available for Wednesday evening
- Larry will verify internet availability at MNA
- Sue will have copies of materials (Agenda, Site Scoring Criteria and Site Scoring Sheets) for participants at registration
- Sue has someone to help with registration, has nametags

Agenda-
Facilitation of break-out sessions
Cultural/Historical—Kelley Hays-Gilpin
Ecosystem/Habitat –Shaula Hedwall
Information/Science –James Hogan
Legal/Political/Socioeconomic—Kathy Jacobs (suggested backup Bob Michaels)

During lunch core team will review work of break-out sessions and updated materials for afternoon session

Site Scoring Sheet and Criteria Finalize Maps for Workshop

- Don will get aquifer info to Mark by Monday for map
- Divide aquifers into basins of study
- Add site type column to the matrix
- Abe will make changes and send revised list to Sue for distribution to Core Team—we won't have list for workshop participants. Mark will keep it on computer as a dynamic document for updates at the workshop
- Sue will send out latest (and correct) version of site scoring sheet to core team

Summary Report of Workshop Results

- Will include revisions to site scoring and evaluation
- Larry and Abe will work on reports from workshop
- Mark will compile summaries from spread sheets
- Maps will be updated as desired/necessary
- Scheduled next meeting of core team for May 29 at 8:30 to review

6. Core Team Meeting
AWI CPWAC TAC
Research Project
Coconino Plateau At-Risk Water Resources
Wednesday, June 4, 2008, 1:00 p.m.

In attendance via phone: Abe Springer, Sue Pratt, Jeanmarie Haney, Shaula Hedwall, James Hogan, and Larry Stevens

Debriefing of April 30/May 1 Workshop
The feedback on the workshop was overall positive. James thought there was good progress made with the site criteria and scoring. Abe said he had heard concerns regarding sites aren't all list, but he emphasized that the list compiled at the workshop was not intended to be exhaustive, that the project is about refining the methodology. Sue noted that when she gave the report at the TAC meeting Leslie Meyers had said that a recommendation from her workshop group was that the same people perform the review for consistency. Abe pointed out that with the research project it would be better to have different people do the reviews to get more feedback on the criteria and scoring. Jeanmarie noted that the workshop didn't address risks as much as values.

Review Revised Site Scoring Sheet and Criteria
Larry reviewed the revised site scoring sheet and noted that tab 2 on the excel spread sheet is the text.

Assignment:
- Larry asked everyone to review the materials, including the text, and send comments back.
- Abe asked everyone to score something using the revised sheet and get the comments back to Larry-Abe suggested using Coyote Springs
- Larry will complete the symposium report—team should submit comments on that too. It will become part of final report prepared by Larry and Abe.

Identify Next Steps
Abe said that the next steps are testing the methodology on sites identified at the workshop, with another round of scoring and revisions as needed. Abe said that the site assessments would include both office exercises and site visits. Larry questioned how the cultural interpretation will be done—perhaps visits to Hopi and/or Navajo water resource staff.

Assignments

- Jeanmarie will write a paragraph on value/risks to add to the assessment strategy
- Send out final workshop report to participants and invitees first week of July (or thereabouts!) and ask for comments by early August. The report will be finalized after that.
- Field Visits—we'll look at list of sites to determine which ones require field trips, when these will occur, etc.
- Chris will get GIS products from workshop from Mark and follow up on finalizing those and getting them out to the group.
- Chris will get assessment data on individual sites done at workshop to Larry
- Larry will send out outline of final report-workshop will be one chapter of full report.

Next Meeting

Provide comments on matrix and criteria electronically
July 8—agenda will be to review draft report and discuss GIS maps and web site

Review of attendees- Sue said that right now they were at 43 for both Wednesday and Thursday. Sue will follow up with Steve Martin from Grand Canyon National Park and David Kreamer.

Discussion of press release-since any release would need to be run through CPWAC, NAU, and MNA it was decided that we would do a formal release after the workshop and in the meantime Sue would get in touch with Cyndy Cole from the Arizona Daily Sun and see if she could attend Wednesday event, and Abe will follow up with NAU.

Core Team Meeting July 8, 2008 9:00 a.m.
AWI CPWAC TAC Research Project Coconino Plateau At-Risk Water Resources

Thomas Auditorium Coconino County Complex 2500 N. Fort Valley Road Flagstaff, Arizona

Present: Abe Springer and Sue Pratt, and James Hogan via phone

Review Report and Latest Version of Site Scoring Sheet

- Abe will get new master revised scoring sheet out to group

Discussion of GIS maps and web site

- Core Team needs to develop list of maps for Mark and Chris to send out – need to have maps before school starts

Discussion of Site Visits and Report Writing

- Abe, Larry, and Chris will work on scoring 10-12 sites

Next Steps

- Need to work on getting contacts for Navajo and Hopi in how to engage in discussion with tribal reps related to cultural, natural resource officers. Work with Tribal reps on TAC, also Shaula has some contact info.

Core Team Meeting September 15, 2008 9 a.m.
AWI CPWAC TAC Research Project--Coconino Plateau At-Risk Water Resources
Thomas Auditorium, Coconino County Complex, 2500 N. Fort Valley Road, Flagstaff, Arizona

Present: Abe Springer, Larry Stevens, Sue Pratt, Brad Hill, Don Bills, via phone: Shaula Hedwall, Jeanmarie Haney

Review Report and Site Scoring

- Jeanmarie wants to provide some paragraphs on the approach
- Questions about including original draft of criteria in report-discussion about maintaining paper trail of research project, Larry mentioned that the legal/political/socioeconomic fell out as part of workshop process and that needs to be captured in the report. It was noted that these aspects were to be considered under "other criteria." All agreed to keep the original in as an appendix with enough information to make sure it is clear it is not the final version. Appendix E needs to be the original (it wasn't in version sent out for meeting). Also need to make sure the text of the report addresses the discussion regarding eliminating legal/political/socioeconomic from scoring and moving to "other criteria."
- Larry noted that the Native American Cultural Issues category is difficult to complete due to sensitive nature of the sites, and also the need to have funding source to provide resources to the tribes to have their cultural staff score.
- Larry noted that there was not much historical expertise at the workshop to help in scoring the test sites.

Discuss and complete any scoring for incomplete sites

- Larry suggested having team members take the lead on the four different water types to coordinate and complete the scoring. The deadline for scoring was set for October 15. Larry and Abe--Streams and Springs, Don Bills and Brad Hill – Coconino Plateau Aquifers, Sue-Lakes, Jeammarie will take the lead on the Verde which includes Sycamore, Oak, Beaver, and West Clear Creeks.
- Larry will send out spread sheets for assessments that were done at the workshop-agreed to limit to 12 total sites.
- Larry said that the research project sets the stage for the next phase

Discuss how to address cultural and tribal issues

- Larry explained some of the information he's obtained related to the tribal needs. It was agreed to add wording to the report that the tribes will need funding in order to provide more information. There are issues associated with various tribes claiming affinity to different resources. It may result in getting scoring from the tribes, but not the background or basis of the scoring. Larry sees this as a next step for further dedicated research.

Identify any outstanding issues to include in report

- The report needs to clearly identify next steps and funding to pursue those. Jeanmarie suggested that it would be a broader inter-disciplinary team. Larry said that it should include expertise for each category.
- Abe mentioned the next round of AWI grant opportunities for concept proposals. Larry thinks the next phase could run $200,000 to $300,000.
- Discussed whether this could be used to support the EIS for the NCAWSS feasibility study.
- Larry mentioned that all of the Forests are working on management plans.
- There was discussion about tying into work with other watershed groups possibly including Yavapai, Gila, and Little Colorado River, for a regional approach.
- University collaborators

Discussion of web site

- Sue offered the CPWAC web site as place for report, Abe said a two page summary will go on AWI web site.
- There was discussion of having cross-links between sites
- Scoring Sheets should be Appendix F and all sheets for each site should be in Excel and available for download
- Link to GRAIL for GIS maps-include just static maps on the CPWAC site.

Next Steps

- Report to TAC October
- Possible Draft Report to WAC October
- Final report to WAC in November
- Final Report Complete December

APPENDIX B:

ELECTRONIC DATA ASSOCIATED WITH PROJECT MAP
(Electronic format only)

APPENDIX C:

SYMPOSIUM INVITED AND PARTICIPATING INDIVIDUALS AND ORGANIZATIONS

Museum of Northern Arizona Brannigar-Chase Conference Hall
30 April 4:00-7:00 p.m., and 1 May 8:00 a.m. – 5:00 p.m.

INVITEES

Acheson, Amanda	Sustainable Building Coordinator, Coconino County
Archuleta, Liz	Chairman, Coconino Plateau Water Advisory Council Supervisor, Coconino County Board of Supervisors
Bills, Don	USGS – Flagstaff
Baker, Barry J.	Tusayan- Valle Representative
Burke, Kely	Grand Canyon Wildlands Council
Coder, Chris	Yavapai-Apache Nation
Fortune, John	Arizona Department of Water Resources
Fowler, Lena	Navajo Nation
Graser, Leslie	Arizona Department of Water Resources
Hamburg, Stacey	Sierra Club
Haney, Jeanmarie	The Nature Conservancy
Haughey, Joe	City Coucilman, City of Flagstaff
Hays-Gilpin, Kelley	NAU-MNA
Hedwall, Shaula	Fish and Wildlife biologist, FWS Ecological Services,
Held, Rodney	
Hill, Brad	City of Flagstaff
Hogan, James	University of Arizona
Jacobs, Kathy	Arizona Water Institute
Kocjan, John	Vice Mayor, City of Page
Kreamer, David	Hydrologist, UNLV
Lovely, Collis	Audobon Society
Manone, Mark	NAU – GRAIL
Metzger, Mandy	Diablo Trust
Meyers, Leslie	Bureau of Reclamation

Michaels, Robert	Chief Program Development, Bureau of Reclamation
Monroe, Stephen	Hydrologist, NPS, So. Colorado Plateau I&M Network
Nuvamsa, Ben	Chairman, Hopi Tribe
Pellatz, Randy	City of Flagstaff
Pratt, Sue	Coconino County Community Development
Rasmussen, John	Coordinator, Yavapai county Water commission
Rice, Steve	Grand Canyon National Park
Rueter, John	Hydro Resources
Roberson, Joelynn	Hopi Tribe
Diana Shebola	Hopi Tribal Councilwoman
Silbert, Shelley	NAU
Smith, Brenda	United States Fish & Wildlife Service
Springer, Abe	AWI – NAU
Steinke, Rory	Coconino National Forest
Stevens, Larry	MNA Biology
Swanson, Rick	City of Flagstaff
Tallsalt-Robertson, Jolene	Navajo Nation
Taylor, Carl	Coconino County Board of Supervisors
Tewa, Marilyn	Hopi Tribe
West, Patty	Center for Sustainable Environments, NAU
Weiss, Dannette	Fisheries Biologist, Arizona Game & Fish Dept, Region 1
White, Cynthia	Friends of Flagstaff's Future
Whitmer, Tom	Manager Statewide Water Resurces, Department of Water Resources
Hopi Tribe	c/o Joelynn Roberson
Hopi Tribe	c/o Joelynn Roberson
Hopi Tribe	c/o Joelynn Roberson
Peru, Steve	County Manager, Coconino County
Wells, Dennis	City of Williams

SYMPOSIUM ATTENDEES

Kaki Rawland	AACD - Verde URCD	**30-Apr-08**	**1-May-08**
Joe Haughey	City of Flagstaff	√	√
Dave Kreamar	Univ. Nevada Las Vegas	√	
Everett Calnimptewa	Hopi Tribal Rep.	√	
Leslie Meyers	Reclamation	√	√
Bob Michaels	Reclamation	√	√
Shaula Hedwall	US Fish and Wildlife Service	√	√
Carl Taylor	Coconino County	√	√
Tom Whitmer	ADWR	√	
Steve Rice	Grand Canyon Hydrologist	√	√
Collis Lovely	Audubon	√	√
Leslie Graser	ADWR	√	√
John Fortune	ADWR	√	√
Alph H. Secakuku	Hopi Tribe	√	√
Barry J. Baker	Tusayan	√	√
Nada Talayumptewa	Hopi Tribe	√	√
Phillip Quochytewa	Hopi Tribe	√	√
Shelley Silbert	NAU	√	√
Rick Swanson	City of Flagstaff	√	
Patty West	NAU-EMA	√	√
James Hogan	UofA – Sahra	√	√
Stacey Hamburg	Sierra Club	√	√
Don Bills	USGS	√	√
John Kocjan	City of Page	√	√
Jeri Ledbetter	MNA	√	√
Rodney Held	ADWR	√	√
Dianna Shebala	Hopi Tribe	√	√
Brad Hill	City of Flagstaff	√	√
Kelly Hays-Gilpin	MNA/NAU Anthropology	√	√
Brenda Smith	USFWS	√	
Dave Smith	USFWS	√	
Liz Archuleta	Coconino County	√	
Stephen Monroe	National Park Service	√	√
Sue Pratt	Coconino County	√	
Randy Pellatz	City of Flagstaff	√	√
Chris Coder	Yavapai-Apache Nation		√
Lena Fowler	Navajo Nation Water Rights Commission		√
Jeanmarie Haney	The Nature Conservancy		√
Damette Weiss	AGFD		√
Cynthia White	Friends of Flagstaff's Future		√
Robert Kirk	Navajo Nation DWR		√
Joelynn Roberson	Hopi Tribe		√
Dirk Renner	USFS - Coconino		√

APPENDIX D:

DR. ABE SPRINGER'S PRESENTATION ON THE STATUS OF COCONINO COUNTY WATER RESOURCES

(Attached electronically as a .pdf file)

APPENDIX E:

DRAFT SCORING SHEET AND SCORING CRITERIA INITIALLY PROVIDED TO SYMPOSIUM PARTICIPANTS (COMPARE WITH FINAL VERSIONS IN TABLES 1 AND 2)

Draft Scoring sheet originally presented to symposium participants.

Coconino County At-Risk Waters Candidate Site Scoring Sheet				
Site Name:				
Site Number (if any):		**General / Regional Risks**	**Risk Score**	**Comments**
Location:		Climate Change/Drought		
Land Ownership:		Land Use/Land Cover Change		
Legal Status:		Groundwater Development		
Proposer:		Surface Water Resources Development		
Assessment Preparers		Water Quality		
Assessment Date:		Contamination		
Overall Site Score	#DIV/0!	**Regional Risk Score**	**#DIV/0!**	
Overall Site Risk Score	#DIV/0!	**Percent Missing Cells**	**100.0**	
Comments:				

Value, Risk Ranking:	**0 – none, 1 - very low, 2 - low, 3 - moderate, 4 - moderately high, 5 - high, 6 - very high**				
Category	**Subcategory**	**Value Score**	**Value Comments**	**Risk Score**	**Risk Comments**
Physical System	Hydrology				
Physical System	Geology/Geomorphology				

Physical System	Water Chemistry/Quality				
Physical System	Meteorology/Climate				
Physical System	Information and Understanding				
Physical System	**All Subcategories**	**#DIV/0!**		**#DIV/0!**	
Ecosystem / Habitat	Ecosystem (Aquatic-Terrestrial) Integrity				
Ecosystem / Habitat	Ecosystem Uniqueness				
Ecosystem / Habitat	Ecosystem Complexity				
Ecosystem / Habitat	Patch Dynamics*				
Ecosystem / Habitat	Rare, Endemic, ESA Listed Species				
Ecosystem / Habitat	Abundance of Native vs Non-native spp.				
Ecosystem / Habitat	Impact of Non-Native Species				
Ecosystem / Habitat	Information and Understanding				
Ecology / Ecosystem Score	**All Subcategories**	**#DIV/0!**		**#DIV/0!**	
Native American Cultural	Ethnobiology				
Native American Cultural	Site Sacredness				
Native American Cultural	Traditional Cultural Property				
Native American Cultural	Education				
Native American Cultural	Information and Understanding				
Native American Cultural Score	**All Subcategories**	**#DIV/0!**		**#DIV/0!**	
Historical	Exploration History				
Historical	Settlement History				
Historical	Contemporary History				
Historical	Science History				
Historical	Education Potential				
Historical	Information and Understanding				
Historical Score	**All Subcategories**	**#DIV/0!**		**#DIV/0!**	
Socioeconomics	Recreation				
Socioeconomics	Water supply				

Socioeconomics	Water quality				
Socioeconomics	Information and Understanding				
Socioeconomics Score	**All Subcategories**	**#DIV/0!**		**#DIV/0!**	
Other Criterion 1					
Other Criterion 2					
Other Criterion 3					
Other Score	**All Subcategories**	**#DIV/0!**		**#DIV/0!**	
Overall Score	**All Subcategories**	**#DIV/0!**		**#DIV/0!**	
Uncertainty Count	**Number of Missing Cells**	**29.00**		**29.00**	
Uncertainty Percent	**Percent of Missing Cells**	**100.00**		**100.00**	

Draft scoring criteria originally presented to symposium participants.

Category	Subcategory	Resource Value Score						
		0	1	2	3	4	5	6
Native American Cultural	Archaeology	None	Very little	Unimportant	Moderately important	Important	Very important	Critically important
Native American Cultural	Tribal History	None	Very little	Little	Moderate	Good	Very good	Excellent
Native American Cultural	Ethnobiology	None	Very little	Unimportant	Moderately important	Important	Very important	Critically important
Native American Cultural	Site Sacredness	None	Very little	Little	Moderate	Good	Much	Excellent
Native American Cultural	Trad. Cultural Property	None	Very little	Unimportant	Moderately important	Important	Very important	Critically important
Native American Cultural	Education	None	Very little	Unimportant	Moderately important	Important	Very important	Outstanding
Native American Cultural	Information and Understanding	Not quant-ified						
Historical	Exploration History	None	Very little	Little	Moderate	Good	Much	Exceptional
Historical	Settlement History	None	Very little	Little	Moderate	Good	Much	Exceptional
Historical	Contemporary History	None	Very little	Little	Moderate	Good	Much	Exceptional
Historical	Science History	None	Very little	Little	Moderate	Good	Much	Exceptional

Historical	Education Potential	None	Very little	Little	Moderate	Good	Very good	Outstanding
Historical	Information and Understanding	Not quant						
Legal / Political	Ownership - stewardship responsibility	None	Federal	State	Environmental NOGs	Federal	Private w/Conservation	Tribes
Legal / Political	Water rights	None						Adjudicated
Legal / Political	Management	None	Vague, not written	Limited, not written or implemented	Written, not implemented	Written, implemented, some monitoring	Written, well-managed and monitored	Scientifically adaptively managed
Legal / Political	Information and Understanding	Not quant						
Ecosystem / Habitat	Ecosystem (Aquatic-Terrestrial) Integrity	None	Very poor	Poor	Fair	Good	Very good	Excellent (pristine)
Ecosystem / Habitat	Rare, Endemic, ESA Listed Species	None	formerly	possibly 1 species	At least one	Several (2-3)	Quite a few(3-6)	Many (>6)
Ecosystem / Habitat	Ecosystem Uniqueness	None	Very common	Common	Unusual	Rare	Very rare	Exceptionally rare
Ecosystem / Habitat	Ratio Nativ/Non-native Species	None	Very low (1-10%)	Few (10-33%)	Moderate(33-67%)	Good (67-95%)	Very good (95-99%)	All (>99%)
Ecosystem / Habitat	Ecological Complexity	None	Very low complexity	Low complexity	Moderate complexity	Complex, not exceptional	Highly complex, highly interactive	Excellent
Ecosystem / Habitat	Patch Dynamics*	Patch issues eliminated	none	slight connectivity	Moderate connectivity	Good connectivity	Very good connectivity	Complete connectivity
Ecosystem / Habitat	Impact of Non-Native Species	100% impact	Very high impact	high impact	moderate impact	low impact	very low impact	No impact

Ecosystem / Habitat	Habitat Quality	Habitat eliminated	Very low	Low	Moderate	Good	Very good	Excellent
Ecosystem / Habitat	Information and Understanding							
Physical System	Hydrology	None	Very little	Low	Moderate	Good	Very good	Outstanding
Physical System	Geology/Geomorphology	None	Very little	Low	Moderate	Good	Very good	Outstanding
Physical System	Water Chemistry/Quality	None	Very little	Low	Moderate	Good	Very good	Outstanding
Physical System	Meteorology/Climate	None	Very little	Low	Moderate	Good	Very good	Outstanding
Physical System	Information and Understanding	Not quant	Very little	Low	Moderate	Good	Very good	Outstanding
Socioeconomics	Recreation	None, eliminated	Very low	Low	Moderate	Good	Very good	Excellent
Socioeconomics	Water supply	None, eliminated	Very unsustainable	Very limited supply	Moderate supply	Good supply	Very good	Abundant supply
Socioeconomics	Water quality	None, eliminated	Very poor	Poor	Moderate	Good	Very good	Excellent
Socioeconomics	Information and Understanding							

APPENDIX F:

SCORING SHEETS FOR AT-RISK WATER RESOURCE SITES EVALUATED BY THE SYMPOSIUM PARTICIPANTS AND CORE TEAM MEMBERS

(Data provided electronically in Microsoft Excel format)