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Tribal Ecosystem Research Program (TERP) Workshop

March 18 – 20, 2014 • Las Vegas, Nevada

Proper Functioning Condition (PFC) Assessment for Management and Monitoring

RESEARCH AND DEVELOPMENT

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Proper Functioning Condition (PFC) Assessment for Management and Monitoring

Report to USEPA ORD NERL Environmental Sciences Division (ESD)

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Acronyms and Abbreviations

BMP – Best Management Practice

CWA – Clean Water Act

DPC–Desired Plant Community

ESD–Environmental Sciences Division

FACW–Facultative Wetland

FAR–Functional At Risk

IRMP–Integrated Resource/Riparian Management Plan

LWM–Large Woody Material

NERL–National Exposure Research Laboratory

NF–Nonfunctional

OBL–Obligate Wetland

ORD –Office of Research and Development

PAR–Products, Assimilation, Resiliency

PFC – Proper Functioning Condition

PNC–Potential Natural Community

PPC–Potential Plant Community

TEK – Traditional Environmental Knowledge

TERP–Tribal Ecosystem Research Program

TMDL – Total Daily Maximum Load

UNLV–University of Nevada Las Vegas

USEPA – US Environmental Protection Agency

WQS – Water Quality Standards

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Instructors for the workshop were from the University of Nevada, Cooperative Extension Program, US Forest Service, USEPA Office of Research and Development along with USEPA Region 9 and the National Resource Conservation Service. The Workshop included field visits to the Pabco section of the Las Vegas Wash and Cold Creek, Nevada which is northwest of Las Vegas near the Nevada National Security Site. Fourteen people participated in the training, including members of the Navajo Nation, Ak-Chin, Napa Nation, Bear River Band of the Rohnerville Rancheria, Coyote Valley Band of the Pomo Indians, La Posta Tribe, San Manuel Band of Mission Indians, Cahto Tribe, Laytonville Rancheria, Bridgeport Colony and the Jamul Indian Village. Thanks go to the manuscript reviewers Don Ebert and Jim Hurja. Many thanks also go to Tad Harris, Pamela Grossmann, Maria Gregorio, May Fong, Kevin Broadnax and Jan Contreras who all aided in the preparation of this report.

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Executive Summary

USEPA is developing alternative approaches to quantify improvements to impaired waterbodies (USEPA 303(d)/TMDL Draft Guidance). Tribal environmental programs are leading the way in the paradigm shift towards sustainability of natural resources. Resources such as wildlife, aquatic habitat are dependent on the development of a riparian and upland management strategy, which considers and adapts to certain ecological relationships. Tribal traditional environmental knowledge (TEK) is a central concept in the cultural and resource stewardship practices of Native Americans. Native American populations have been accumulating knowledge of these ecosystem relationships, and have relied on them for basic survival for thousands of years. As such, TEK is the accumulated understanding of ecosystem function.

As North America's first environmental stewards, Native American populations have developed a unique relationship with the land and its resources. Objective of this workshop was to fuse TEK with environmental science to create an ecosystem, or the landscape, research program oriented toward land management practices. This is essentially translating and combining TEK with an ecosystem function approach to provide a comprehensive basis for identifying and evaluating current and historical land use practices.

Tribal and USEPA cooperative stream and wetland research focuses on making the connections between upland and riparian ecosystems. Analyzing spatial relationships and short- and long-term trends can determine if goals and objectives are being met (USEPA 303(d)/TMDL Draft Guidance). Defining ecosystem function potential will determine what changes are needed for moving the ecosystem toward the desired condition and developing and comparing management alternatives (i.e., TEK). The Proper Functioning Condition (PFC) protocol, developed by the Bureau of Land Management, refers to how well the physical processes within a stream and wetland riparian area are working and able to sustain a state of resiliency during high-flow events. This resiliency allows an area to provide valued ecosystem services (e.g., fish habitat, livestock and/or wildlife forage, water purification, carbon storage and nutrient cycling), and to sustain the area over time.

Ten Tribes attended the workshop. Primary interest is in the sustainability of natural resources and their ecological services to meet the nutritional, cultural, societal and economic needs of Tribal communities.

Funding for this workshop was provided by the USEPA Office of Research & Development (ORD), National Exposure Research Laboratory (NERL), Environmental Sciences Division (ESD), Las Vegas, Nevada.

1.0 Workshop Objectives

The purpose of this workshop was to bring together Tribal environmental scientists with USEPA ORD physical, biological and social scientists to develop and conduct collaborative sustainable ecosystem research. The objective was to open a communication process as part of a technology transfer to merge ecological science and Tribal traditional ecological knowledge (TEK). Collaborative research was set to understand the linkages between traditional knowledge, locally evolved management systems and human health and well-being to enhance the evolution of ecosystem services sciences.

Each session in the workshop agenda is designed to illicit discussion of Tribal research needs (Appendix 1). Workshop sessions are:

1. Ecosystem Services
2. Ecological Function and Sustainability
3. Products, Assimilation, Resiliency (PAR)
4. Soils
5. Proper Functioning Condition (PFC)
6. Connecting Tribal Values to Management
7. Results of Current EPA Research
8. Tribal Research Needs/Projects

The second USEPA-Tribal Environmental Research Program (TERP) workshop was attended by representatives from ten different tribes (Appendix 2 - Southern California (3), Northern California (4), and Arizona (3)). USEPA was represented by scientists from USEPA Region 9, USEPA ORD NERL/ESD, University of Nevada, Reno, US Forest Service, Bureau of Land Management (BLM), and DoA Natural Resource Conservation Service (NRCS).

Figure 1.Robin Wignall, USFS and Dan Heggem, USEPA Showing Workshop Attendees "Colonizing" and "Stabilizing" Vegetation

Figure 2. Robert Hall, USEPA Region 9, Discussing Workshop Concepts with Fred Johnson, Navajo Nation.

1.1 Tribal Ecosystem Research Program (TERP) Description

The goal of the Tribal cooperative research program is to investigate the feasibility of using an ecosystem function approach to assess the ecological, economic and social ramifications of alternative land management scenarios. These scenarios emphasize the historic ties Tribal populations have to the land, their unique cultural and dietary practices and ecosystem services. The objectives of the TERP is to provide information and tools allowing communities, planners, and policy makers to evaluate holistically upland and riparian area management practices, and the impacts of water- and land-use decisions.

On the organized field trip, discussions included current research efforts in the areas of resource management, stream and wetland riparian functions, USEPA water quality and biological assessment (CWA Section 106), and restoration programs (CWA Section 319). Tribes present at the workshop represented southwestern ecoregions (Mojave Desert, Southern California Coastal, and Northern California coastal woodlands).

The workshop emphasized ecosystem management. The sustainability of the aquatic habitat and wildlife depends on the development of a riparian area management strategy that considers and adapts to certain ecological, social, and economic relationships.

An effective adaptive ecosystem management plan, is based on ecological functions of stream and wetland riparian areas and uplands. Tribes are first and foremost a land management agency. Any adaptive management plan needs to incorporate Tribal values. USEPA regulatory activities (i.e., WQS, TMDL process, Air regulations, etc.), monitoring and funding programs can and should be used to support Tribal ecological life ways implementation.

The Tribal TERP Project Addresses the Following Priorities:

a. Protecting Tribal Water Resources,
b. Managing for Tribal Cultural Natural Resources (Aquatic, Wildlife)
c. Expanding the Use of TEK to Take Action on Climate Change,

1.2 What are the Specific Ecosystem Functions (i.e., Services) the Tribe Needs Research On?

Tribal Research and Technology Transfer needs are:

1. Stream and Wetland Riparian System Function:
   a. Connecting Water quality standards (i.e., biological, chemical), riparian and upland biological indicators and criteria development to habitat restoration and integrating resource adaptive management plans (i.e., grazing, agriculture, mining, logging, etc.)

2. Development of Adaptive Management Plan:
   a. Water distribution (i.e., surface water, groundwater) and quantity (e.g., water rights related issues, storage capacity, etc.),

3. Ecological Connection Between Upland and Riparian Ecosystems, and Land Use Practices:

a. Ecosystem sequestration potential for nutrients (carbon, nitrogen, phosphorus, trace metals, etc.)

To give an example of a Tribal need driven ecosystem research, a previous private land owner, who shares a common boundary to a tribal reservation, initiated an in-stream dredging project. The project resulted in over steepening of the river channel causing a nick point (i.e., head cut) to migrate up the system and excess sediment to be deposited further downstream. The upstream migrating channel incision is disconnecting the river channel from accessing the riparian area, which are being used as agricultural hay fields. Channel incision has lowered the water table, and resulted in the Tribal irrigation canal system to become disconnected from the stream. The Ecosystem Research Team (i.e., Team) worked with each land/assignment owner (private/Tribal/public) to asses Project research needs to:

a. Determine the potential functionality of the system,
b. Appropriate BMP and cost for repairing the channel to its potential functionality,
c. Cost of lost agricultural products,
d. Invasion of upland dry land plant migration into riparian habitats, and invasive and noxious weeds resulting from dropping groundwater levels and disturbance,
e. Impacts to water quality and aquatic resources (i.e., fisheries) and wildlife habitat, along with the selling of recreational permits by the tribe

1.3 What are the Biophysical Aspects?

Stream and wetland riparian ecosystems have the capacity to sequester pollutants and retain nutrients. Fish and wildlife habitats depend on riparian areas to function properly. Loss of function and physical form impacts the assimilation processes, releases sequestered nutrients, and destroys habitat. In most streams, loss of function causes most, or a significant portion of nonpoint source pollution.

Current research in biophysical products:

a. Stream and Wetland Riparian Plant Community Structure, Soils, Geomorphology and Water
b. Upland Plant Community Structure
c. Aquatic Resources and Wildlife
d. Resource Management Practices (e.g., Grazing Management, etc.)

1.4 What are the Current Indicators being Measured as Part of Tribes' Natural Resource and/or Ambient Monitoring Programs?

Indicators needed to manage water quality issues must focus on the drivers of physical functioning condition. Riparian vegetation is often the best leading indicator for adaptive management and sustainability of water quality and aquatic communities. The results of these projects will be used to improve ecosystem management and develop monitoring programs as part of an adaptive management plan based on Tribal values.

Plant community structure, soil type and geomorphology, channel dimensions (e.g., width, depth, w/d ratio, excess sediment, greenline dimensions, bed substrate, etc.), and flow are leading indicators of performance. These indicators, when collected, analyzed, and understood, are able to predict future events, and assist the land manager in avoiding calamities and manage limited resources.

Water quality and quantity, aquatic and wildlife resources, upland (e.g., percent natural land cover, grazing management practice, etc.), aquatic species type and abundance are lagging indicators, but important measures depending on the question of interest. Water quality parameters can predict risk for certain endpoints (e.g., human health, fish health, etc.). A lagging indicator may eventually respond, but not soon enough to guide decisions needed to ensure progress.

It should be noted, not all water pollution is from an external input. Pollution often comes from the materials long stored in and along riparian areas and wetlands due to their attributes and processes or functions. Riparian vegetation begins to decline first and it consistently leads in indicating sequential recovery.

The scientific principles of ecological function can and will be used by tribes throughout the US in developing sustainable ecosystems.

1.5 Field Exercise

Riparian vegetation is one of the primary ecological attributes affected by human use patterns (i.e., grazing, urbanization, etc.). An inventory or assessment of current vegetation condition in relation to the potential condition is necessary to identify limitation or opportunities. Proper Functioning Condition (PFC) refers to how well the physical processes of energy dissipation, filtering sediment, stabilizing streambanks, groundwater recharge, floodplain development, and maintaining channel characteristics (with vegetation, coarse woody debris, soils, geomorphology, and hydrology appropriate for the potential or capability of the setting) reflect a state of resiliency.

The ultimate goal of the Tribal Water Pollution Control Program (WPCP) is the development and implementation of water quality standards for future protection and sustained use of valuable Reservation water resources, protection of public health and welfare, and the enhancement of water quality. The intent is to protect and improve water resources through habitat evaluation, planning, implementation, education, community outreach and communication, and water quality monitoring.

A component of the WPCP is the development of Non-Point Source Program which is intended to identify non-point sources of pollution and mitigate and/or eliminate them. The U.S. Environmental Protection Agency (USEPA 2006) reports that non-point source pollution is the leading remaining cause of water quality problems. It is also known that non-point source pollution has a direct impact on drinking water and surface water quality and quantity, recreation, fisheries, and wildlife.

The primary objectives of this exercise is to perform an ecological assessment of the Cold Creek area and make recommendations to improve conditions as part of an integrated resource/riparian management plan (IRMP).

The possible outcome of this exercise is the development an adaptive management plan, which will restore stream plant and animal community complexes in the watershed, reduce stream-bank erosion and improve stream water quality, reconnect the stream channel to its floodplain, raise the water table, improve flood attenuation, increasing soil moisture retention, and improving riparian and aquatic habitat for aquatic communities.

2.0 Workshop Preparation

In order to aid the successful completion of future workshops and to encourage people to hold tribal specific PFC workshops the following workshop preparation items are discussed.

2.1 Announcement

The workshop announcement or invitation is a very important part of the workshop preparation activities. The announcement should be attractive, simple, timely and informative. The announcement for this work shop can be found in Appendix 1. This was a two page announcement. The workshop purpose, benefits, location and dates were listed on the front page. The workshop agenda is on the back. Pictures of past workshops were located on the side of the page to show the future participants what the workshop experience would be like if they attend. Sign up instructions and contacts for questions were located at the bottom of the first page. The announcement was distributed by way of hard copy, email and webpage. People were able to show this announcement to their supervisors and coworkers to indicate what benefits attending the workshop would bring to their organization.

2.2 Classroom Learning Materials

The classroom portion of this workshop was held in the US EPA, Environmental Sciences Division's Executive Center Auditorium. The Auditorium has comfortable seating with fold out writing tables in each chair, full audio/visual/internet resources and a lecture podium. Each participant was given a writing tablet, pen and pencil and the two PFC manuals (Pritchard et al., 1993; Pritchard et al., 1996). Copying service and IT end user support were required on demand during the classroom portion of the workshop. A photographer and videographer were present to document portions of the workshop for later use. Light snacks, water, juice and coffee were available on the first morning session. The highlight of the PFC Workshop classroom session was the presentation materials provided by the Nevada Creeks and Communities Team. There are over 470 slides in the PFC Workshop presentation. Classroom time was approximately a day and a half. The following Figures 3 – 6 are selected slides from the workshop classroom session. The classroom lecture gives the participants the basic concepts of PFC, helps them to learn the PFC vocabulary , shows good examples of what attributes are measured, gives a quiz and proposes management practices for function recovery.

Figure 3. Dr. Sherman Swanson beginning the Classroom Presentation.

Figure 4. Sample Slide from the Classroom Presentation - Number 1.
Since riparian-wetland areas often pass through or are shared by numerous landowners, a collaborative approach, applied at the ground level in a watershed context, is the only avenue to successful restoration and future management.

Figure 5. Sample Slide from the Classroom Presentation - Number 2.
The initiative's mission is "healthy streams through bringing people together," and it is based on premise that "restoration will not happen by regulation, changes in the law, more money or any of the normal bureaucratic approaches. It will only occur through the integration of ecological, economic and social factors, and participation of affected interests."

Figure 6. Sample Slide from the Classroom Presentation - Number 3.
Example of PFC at work in Bear Creek. Notice the recovery of the stream channel and flood plain vegetation. Workshop participants learn that with PFC information in hand meaningful land management changes can be made to aid recoveries like this one at Bear Creek. These lecture materials were from the Nevada Creeks and Community Team and can be found at, http://www.cabnr.unr.edu/swanson/Extension/PFCTeam.aspx.

2.3 Field Training Site Selection

As important as the classroom session is the field sessions are where the majority of the PFC learning takes place. The Las Vegas valley is located in the Mojave Desert; and therefore, is usually very dry. Ephemeral or intermittent streams or washes make up the vast majority of the water bodies in the valley. The desert landscape presented challenges in the quest for field training sites.

Training sites should reflect the different conditions in the PFC rating such as proper functioning, functioning at risk, and nonfunctional. If differing conditions can't be found, there is still much to learn from any one of the three categories. Having water present during training is preferable. Communicating with local water authorities can be very helpful as streams and wetlands can be managed for water levels according to the time of year. Access is also very important in various ways. Landowner or land manager permission should be granted before field site visits. A park or recreation facility can be an ideal place for field training. This facilitates ease of parking, access to restroom facilities, picnic areas for lunch, and usually included pathways to the stream banks or wetland area. Park Rangers, land managers and land owners can be a tremendous resource for participants when seeking information about the land use history of a park or recreation area. The field sites should also be located close to the classroom area so that transport to the field sites is not more than two hours driving time.

Preparation for this workshop included visits to various locations throughout the Las Vegas Valley. The first step was to try to locate areas using internet mapping applications. Figures 7 through 8 show some of the preliminary candidate locations on maps. Figure 7 is a satellite view of Red Springs park located in the northwest part of the Las Vegas valley near the Spring Mountains. This site had parking, rest facilities and a picnic area but did not have enough open water to accommodate a full PFC assessment. Spring Mountain Ranch State Park (Figure 8) was also considered as a possible field learning site but was rejected due to the difficult access to the stream side for assessment purposes.

Figure 7. Red Springs Park Satellite Map View.

Figure 8. Spring Mountain Ranch State Park.

After looking at maps for suitable locations candidate sites were visited. What may look good on a map may not be acceptable as observed on the ground. Las Vegas Wetland Park looked acceptable from maps and satellite views but as observed for the ground lacked access to the stream and stream banks for close observation. Figure 16 shows Las Vegas Wash at the Wetland Park and difficulty of access which includes a six meter drop from the upland land area.

Figure 9. Las Vegas Wash at the Las Vegas Wetland Park.

The field training sites that were selected were the PABCO section of the Las Vegas Wash and Cold Creek, Nevada. Both sites met the pre selection criteria and are discussed in later sections of this report.

2.4 Field Learning Materials

Application of what was taught in the classroom comes in the field learning sessions. It is very important to fully prepare for field related contingencies. Site access permission was obtained and land managers and land owners joined the field session. Participants should be advised to wear comfortable, field oriented clothing as seen in Figure 10.

Figure 10. PFC Participants Ready for Field Observations.

Vans were acquired to transport people and had extra water, light snacks, maps to locations and first aid supplies. As the training progressed, participants were split into groups of four to six people. There were at least two instructors per group. Copies of PFC Manuals (Pritchard et al., 1993; Pritchard et al., 1996) and copies of the PFC Checklists (Appendix 3A and 3B) were available. Instructors should include scientists with expertise in biology (especially plant identification), geology, soil science, ecology, land management, and water quality management. Preplanning is critical as success depends on materials better not left behind requiring a long retrieval process. A photographer and videographer were present to document portions of the workshop field session for later use.

3.0 PFC Methods

Riparian areas are designated as vegetated (i.e., green) zones along lakes, wetlands, rivers, streams, and creeks. Flowing water features such as rivers, streams, and creeks are referred to as lotic riparian area. Wetland areas are associated with standing water features such as bogs, marshes, wet meadows, and estuaries and are referred to as lentic riparian areas. Proper Function Condition (PFC) is a methodology for assessing the physical functioning of riparian and wetland areas. The term PFC is used to describe both the assessment process, and a defined, on-the-ground condition of a riparian-wetland area. Stream function is determined by assessing the hydrology, vegetation, soil, and landform attributes. By focusing on physical functioning, the PFC protocol is designed to yield information about the biology of the plants and animals dependent on the riparian-wetland area. PFC provides information indicating how well a riparian-wetland area is physically functioning in a manner allowing for the maintenance or recovery of desired attributes like, fish habitat, biodiversity, and forage.

Proper functioning condition (PFC) is a qualitative method for assessing stream and wetland riparian area physical processes. PFC is a state of resiliency allowing a riparian-wetland area to hold together during high-flow events with a high degree of reliability. Each riparian-wetland area is judged against its capability and potential (Prichard et al., 1993; Prichard et al., 1996). The capability and potential of natural riparian-wetland areas are characterized by the interaction of the systems hydrology, vegetation and erosion or deposition. Riparian areas are deemed functioning properly when there is adequate vegetative structure present to provide the listed benefits applicable to a particular area. For example, if the system does not have the potential to support fish habitat, that criteria would not be used in the assessment (Prichard et al., 1993; Prichard et al., 1996).

Prichard et al., 1998, notes "Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to 1) dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality; 2) filter sediment, capture bedload, and aid floodplain development; 3) improve flood-water retention and ground-water recharge; 4) develop root masses that stabilize streambanks against cutting action; 5) develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; 6) and support greater biodiversity."

Assessing stream and wetland functionality involves determining a riparian area's capability and potential using an approach such as the following:

- Look for relic areas such as exclosures or preserves;
- Seek out historic photos, survey notes, and documents that indicate historic condition;
- Search out species lists (animals & plants - historic & present),
- Determine species habitat needs (animals & plants) related to species that are or were present;
- Examine the soils and determine if they were saturated at one time and are now well drained;
- Examine the hydrology, establish cross sections if necessary to determine frequency and duration of flooding;
- Identify vegetation that currently exists. Are they the same species that occurred historically;
- Determine the entire watershed's general condition and identify its major landform(s);

- Look for limiting factors, both human-caused and natural, and determine if they can be corrected.

Stream-wetland systems may be prevented from achieving their potential because of limiting factors such as anthropogenic (human) activities. However, most of these limiting factors can be rectified through proper management. Some types of permanent construction (e.g., dams, transmountain diversions, permanent channel modifications), are not as easy to correct. The placement of permanent structures (i.e., dams and diversions) can result in a stream-wetland area's flow regime being altered, thus changing the area's capability. For example, cottonwood trees are maintained by periodic flooding, which creates point bars for seedling establishment. A dam or diversion that reduces or eliminates the potential for flooding may remove the potential for cottonwoods to remain in that area. PFC must be assessed in relationship to the area's capability.

The trend is an assessment of apparent direction of change (e.g., upward or downward) in conditions either towards or away from the site potential or site functionality. The attributes may exhibit some sort of degradation or may exhibit some past degradation with no apparent upward trend. Trend is determined by comparing the present condition of the stream reach (understood in comparison with other reaches within the same systems (i.e., reference condition)), with previous photos, trend studies, inventories, other documentation, or personal knowledge. The lack of historical information on the condition of a site may lead to a "trend not apparent" assessment unless other clues are present such as the population growth of young woody species (e.g., willows).

Nonfunctional areas do not contain sufficient vegetation, landform, or large woody debris to dissipate stream energy associated with high flows.

4.0 Pabco Field Site

Sometimes things work out and sometimes they don't. The Pabco portion of the Las Vegas Wash was chosen as a field learning site due to a convenient location to our research facility in Las Vegas, vehicle parking, restroom and lecture facilities and ease of access to the stream and stream bank. Figure 11 shows the satellite map of the Pabco location.

Figure 11. Satellite Image of the Pabco Field Site.

The issue with using any portion of the Las Vegas Wash for PFC assessment is that the natural grade was ruined in big storm events in the late 1990s. After these big events, the engineering was planned to slow the water down during normal flow and to try to survive big events in the future. Riparian restoration was not considered as a primary outcome of restoration measures. During control structure construction, more big storms hit the Las Vegas Valley, burst through the construction, further ruined the grade and caused big sediment flows into Lake Mead. The control structures were built from 2000 to the present. The total control structure construction is nearly complete. The water quality parameter of concern, total suspended solids, is presently under control. There is no telling what will happen in the next big storm event. The Las Vegas Wash returns well over 95% of water used in the Las Vegas Valley for indoor use. The water in the Las Vegas Wash is treated effluent from Clark County and the cities of Las Vegas and Henderson. Because the water is treated effluent, the present water volume is not a naturally occurring phenomenon.

PFC participants were confused by the “artificial” nature of what they are observing at the Las Vegas Wash. Abandoned channels, weirs, riprap, and new and old vegetation are all present and confound the PFC analyses. When the participants arrived at the Pabco site instructors were able to point out stream bank features, identify vegetation, demonstrate soil characteristics and look at erosion deposition but because of the artificial and therefore confusing nature of the Pabco section of the wash, the lotic checklist of the PFC assessment was not able to be filled out.

Land managers for the Las Vegas Wash should be accounting for function. If they know their functional status then they can make decisions that at least can be measured (function) and begin a management plan that can be put in place and then by understanding function they can start a feedback loop to make even better decisions to get things working the way it needs to work for sustainability and resiliency.

Figures 12 through 14 are photographs of the Las Vegas Wash at the Pabco trail head location. Stream access was acceptable and there was much to be learned from the soil and vegetation types located at this site but PFC analyses was not completed by participants.

Figure 12. Pabco Section of the Las Vegas Wash Looking Downstream.

Figure 13. Pabco Section of the Las Vegas Wash Looking Upstream.

Figure 14. Pabco Section of the Las Vegas Wash Showing a Gravel Point Bar and Vegetation.

5.0 Cold Creek Field Training Site

Figure 15. Photograph of the Cold Creek Watershed. Photograph taken March 19, 2014, by Tad Harris.

Cold Creek, Nevada was suggested by the U.S Forest Service as a potential field training site for the Las Vegas PFC Workshop. The area was appraised by satellite map and a pre visit. The site is a one hour drive from the ORD Las Vegas facility on the UNLV campus. It has a picnic area with a large parking lot and comfort facilities were provided by the Clark County Fire Department, Fire Station 82. This site included both a lentic and lotic areas for evaluation.

The lentic site included two ponds and a water channel connecting the two water bodies. Figure 16 shows a satellite image of the two ponds. A water diversion comes from the main channel of Cold Creek and can be seen in Figure 18. This diversion feeds the first pond (Figure 17) then in turn a channel (Figure 19) feeds the second pond (Figure 20). This water was once used for a ranch which is now abandoned and is now used for fire fighting purposes. This lentic site was assessed for PFC by the workshop participants.

At Cold Creek, we were joined by a landowner at the stream area and a Deputy Fire Chief at the wetland area. The land owner was invited to join our group during the PFC assessment. She told us that there was a large flood event last August/September, 2013 that caused the most damage to the stream. The event resulted in a head cut that proceeded across the road and down into the area of grazing use. While these factors may have contributed to the damage from the from the storm event, we learned from the U.S. Forest Service that it wasn't the main factor. There used to be a picnic area where the road crosses the stream. It has been discontinued for many years. Boulders had been placed years ago to prevent motorized vehicle access and that has been largely successful. Trails are user defined and not a Forest Service system trail and not maintained. They are used by visitors and residents alike. Wild horse use is probably the most significant impact to that stream. Her description of the creeks recent past included vigorous vegetation and stable stream banks lead us to believe that the creek was in a functional state of condition.

The Deputy Fire Chief told us that the wetland area had been created by diverting the creek in the early 20th century. This area use was by ranchers for cattle, horses and entertaining special guests. The water held in the ponds is currently used for fire fighting purposes and in the winter time, these ponds are stocked with fish for recreational fishing.

Figure 16. Satellite Image of the Lentic (Wetland) Field Study Site, Cold Creek, Nevada.

Figure 17. First Pond.

Figure 18. Diversion of Water from Cold Creek to the Ponds.

Figure 19. Water Channel between Ponds.

Figure 20. Second Pond.

The lotic site was one-half mile due west of the lentic site on Cold Creek Road. The satellite view is shown on Figure 21 and is located at the second loop of the switchback in Cold Creek Road next to the vegetation. The study area was on U.S. Forest Service land which started at the road and went to the south.

Figure 21. Satellite Image of the Lotic (Stream) Field Study Site, Cold Creek Nevada.

The pre visit photos can be seen in figures 22 and 23. Vegetation was very thick at points along the stream and horse trails (foot paths) lined the sides of the creek and various points. This stream and riparian vegetation is fed and sustained by a spring just upstream from the assessment location. The workshop participants were able to complete a PFC assessment for lotic conditions at this filed site.

Figure 22. Cold Creek Near Cold Creek Road Pre Visit.

Figure 23. Cold Creek Up Stream Pre Visit.

6.0 Results of Functional Rating

6.1 Potential and Capability

As described in Prichard et al., 1998, potential is defined as the "…highest ecological status a riparian-wetland area can attain given no political, social, or economical constraints, and is often referred to as the potential natural community (PNC)." The potential plant community (PPC) represents the seral stage the botanical community would achieve if all successional sequences were completed without human interference under the present environmental conditions. For some areas, PFC may occur from early seral to late seral. Desired plant community (DPC) would be determined based on management objectives through an interdisciplinary approach. For example, trout habitat conditions would be optimum from mid-seral to late seral.

Capability, as described in Prichard et al., 1998, is defined as the "…the highest ecological status an area can attain given political, social, or economical constraints, which are often referred to as limiting factors." Capability only applies to constraints land/resource managers cannot eliminate or change through some management action.

Cold Creek is a spring fed coarse gravel Rosgen B type stream system. During summer monsoons, the watershed captures thundershower activity to augment the spring discharge. Plant community is comprised of Arroyo Willow, sedge and rush, with some oak and pine trees. The upper reach is impacted by urban development.

The lentic ponds are artificially maintained as a wild horse stock pond, recreational fishing, and as source water for fire fighting. Water is diverted from Cold Creek just below the spring, via a small channel into the ponds.

6.2 Lotic Reach – Cold Creek

Figure 24. Cold Creek Channel and Riparian. Photographs by John Lin.

6.3 Hydrology

Fluvial processes of sediment transport and storage are directly related to stream and wetland riparian habitat dynamics (Hurley and Jensen, 2001). In this section, items 1-5 focus on the hydrologic attributes and processes thought to be necessary for maintaining ecosystem integrity (Prichard et al., 1998).

1. Floodplain above Bankfull is Inundated in "Relatively Frequent" Event.

A floodplain, topographically, is flat area adjacent to a stream (Schmudde, 1968; Alexander and Marriott, 1999). The floodplain is comprised of unconsolidated depositional material (i.e., sediment), and is flooded every 1.5 to 2 years (Schmudde, 1968; Alexander and Marriott, 1999). Natural floodplains vary in character depending on their climatic setting, catchment size and character and, as a consequence, discharge character and sediment load (Prichard et al., 1998). The floodplain is functional if it is normally connected to the stream at the bankfull discharge point, and is flooded in relatively frequent events (Prichard et al., 1998). The floodplain provides additional stream capacity to transport and store water and sediment. If the channel is downcut and flood flows can not access the floodplain, the floodplain is considered non-functional if it no longer provides hydrologic functions (Prichard et al., 1998).

The objective is to determine if frequent flood flows (1.5 – 2 years) are capable of spreading out on a low-lying area adjacent to the stream.

Yes	No	N/A	1. Floodplain above Bankfull is Inundated in "Relatively Frequent" Event.
X			New Flood Plain is Not Terrace or Inset Fan. Floodplain Valley Flat

2. Where Beaver Dams are Present are they Active and Stable.

The objective is to determine if beaver dams are present and are being maintained. For Cold Creek there are no beavers in the area. This question is Not Applicable.

Yes	No	N/A	2. Where Beaver Dams are Present are they Active and Stable
		X	

3. Sinuosity, Width/Depth Ratio, and Gradient are in Balance with the Landscape Setting (i.e., Landform, Geology, and Bioclimatic Region).

The objective is to determine if the stream is balance (i.e., shape and size) with its setting. Sinuosity, width/depth ratio, and gradient play important roles in how well a stream dissipates energy (Prichard et al., 1998). The position of a stream in its landscape and watershed setting is a strong determinant of that stream's ability to develop and support significant riparian-wetland resources (Prichard et al., 1998).

Prichard et al., 1998, indicate that the stream ability to develop and support significant riparian resources is dependent on the position of a stream in its landscape and watershed setting, and its expected range of variability for composition of bed and bank material and channel size, shape and pattern.

For Cold Creek, the width depth ratio and sinuosity are not appropriate for the stream setting. This system is degraded and is not recovering from past channelization, current water diversion and recreational activity. The flood event is too recent to determine the recovery ability.

Yes	No	N/A	3. Sinuosity, Width/Depth Ratio, and Gradient are in Balance with the Landscape Setting (i.e., Landform, Geology, and Bioclimatic Region)
	X		Wide and Less Sinuous and Steeper. Stuck in Linear Incision

4. Riparian – Wetland Area is Widening or has Achieved Potential Extent.

Degraded riparian systems recover by capturing sediment in the floodplain. Riparian areas widen via aggradation, along with natural stream adjustments (e.g. widening of flood plain, sinuosity). This improves flood water retention and aids recruitment of plant communities. Recovery is expressed as an increase in riparian vegetation. The objective here is to determine if the riparian area is recovering or has recovered.

Hoof action and grazing are preventing and/or slowing down widening of the riparian area.

Yes	No	N/A	4. Riparian – Wetland area is Widening or has Achieved Potential Extent.
	X		Bluegrass, Lack of Willows where it Could Grow.

5. Upland Watershed is Not Contributing to Riparian-Wetland Degradation.

Sediment load to a stream is a function of the watershed geology, soils, vegetation cover and land use. Condition of the surrounding uplands can greatly affect the riparian area. For example, changes in upland condition can change the discharge, timing or duration of stream flow events (Prichard et al., 1998). The objective of this item is to determine if there are changes in the water and/or sediment being supplied to the riparian system. Also, determine if the resulting increases are contributing to the degradation of the system. An answer of “No” indicates the upland is contributing.

As Prichard et al., 1998, describe, it is possible to have a disturbed upland area and not see “major changes” to the riparian area. Indicators of riparian degradation area include braiding of what should be a single-thread channel, mid-channel bars, overloading of point bars, fan deposits from upland erosion sinuosity, or cementing (i.e., increased embeddedness) of the channel substrate.

Horse activity, urbanization in the upstream and upland areas are contributing to stream and riparian degradation.

Yes	No	N/A	5. Upland Watershed is Not Contributing to Riparian-Wetland Degradation.
	X		**Combination of Untreated/Poorly Maintained Private Roads, Urbaniztion, Steep Horse Trails, Incision from Below.**

6.4 Vegetation

Stream riparian areas are primarily impacted by the hydrologic and geomorphic processes within the landform setting. For a stream riparian area to achieve functionality, some amount of vegetation is required. Items 6-12 deal with vegetation attributes and processes that need to be in working order for a riparian system to function properly. The lateral distribution of vegetation determines the stream riparian area's ability to accommodate periods of flood and drought conditions. The ability of a riparian area to persist or improve is dependent on having the appropriate vegetative community (i.e., the right kind and amount of vegetation) being vigorous and replacing or increasing their numbers and extent through recruitment (Prichard et al., 1998). As described by Prichard et al., 1998, degradation of a stream riparian area corresponds with the elimination of or reduction in bank-forming vegetation, encroachment of upland vegetation onto floodplains and levees and increase in the extent of eroded banks and stream bars at the expense of vegetated communities on levees and floodplains.

1. Diverse Age-Class Distribution of Riparian-Wetland Vegetation (Recruitment for Maintenance/Recovery).

Prichard et al., 1998, indicate for a stream riparian system to recover, or maintain, it has to have more than one age class of wetland plants. Note: this question is not referring to all possible age classes are present. It is asking if the age classes present are providing recruitment to maintain, increase or allow recovery of an area. Prichard et al., 1998, states that most riparian areas will recover or maintain with two age classes, as long as one of the age classes is young (recruitment) and the other is middle aged (i.e., replacement). Older/mature age classes are well attached to existing water tables and can persist even with degraded conditions.

The objective of the item is to determine the age class distribution of at least one to two species of plants.

It is too early to determined willow regeneration due to the recent flood event.

Yes	No	N/A	6. Diverse Age-Class Distribution of Riparian-Wetland Vegetation (Recruitment for Maintenance/Recovery).
	X		**No Willow Regeneration.**

2. Diverse Composition of Riparian-Wetland Vegetation (for Maintenance or Recovery).

Stream riparian areas require the appropriate vegetation to be present if they are to function properly. This means having two or more riparian wetland species present. Diversity for maintenance or recovery applies primarily to the presence (availability) of those species with high erosion control potential (stabilizers) within a community.

The objective of this item is to determine and document if the existing species composition is sufficient for maintenance or recovery.

For Cold Creek, there is a diversity of vegetation community – Arroyo willow, rush, sedge.

Yes	No	N/A	7. Diverse Composition of Riparian-Wetland Vegetation (for Maintenance/Recovery).
X			Arroyo Willow, Sedge, Rush.

4. Species Present Indicate Maintenance of Riparian-Wetland Soil Moisture Characteristics.

Plants occurring in riparian wetland areas are hydrophytes (Prichard et al., 1998). They have to be in contact with the water table to flourish.

The objective of this item is to determine the water table level is being maintained or is moving towards its potential extent as indicated by the presence of stream riparian plant communities.

A functional riparian system will have obligate wetland (OBL – e.g., cattails, Baltic rush, pondweed, etc.) or facultative wetland (FACW – spiked rush, ferns, etc.) plant communities on a perennial reach. A "no" response for this question will be given if facultative upland or upland (drier site plants) dominant the reach.

For the entire reach, key herbaceous and woody riparian stabilizer plant species are absent and/or have a very minimal presence.

Yes	No	N/A	8. Species Present Indicate Maintenance of Riparian-Wetland Soil Moisture Characteristics.
	X		Very Minimal Presence.

5. **Streambank Vegetation is Comprised of those Plants or Plant Communities that Have Root Masses Capable of Withstanding High Stream Flow Events [Community Types Present].**

All stream banks erode to some degree as part of a stream's natural process. Riparian plants are very effective at stabilizing stream banks, filtering runoff, shading and protection of fish habitats, enhancing aesthetics and controlling downstream flooding. Unstable banks can lead to extensive bank failures and add large volumes of sediment to the stream.

The objective of this item is to document that the streambanks have the right plant community types for recovery and maintenance of the riparian wetland area. Most plants that are obligate and facultative wetland have root masses capable of withstanding hig-flow events (Prichard et al., 1998).

Cold Creek lacks a stabilizing plant community.

Reach 1.

Yes	No	N/A	9. Streambank Vegetation is Comprised of those Plants or Plant Communities that have Root Masses Capable of Withstanding High Stream Flow Events [Community Types Present].
	X		No Stabilizers. Colonizing Bluegrass is the Dominant Species.

5. **Riparian-Wetland Plants Exhibit High Vigor.**

For most stream riparian wetland areas, plant size, shape and leaf color during the growing season can be used to discern vigor (i.e., robustness, health).

The objective of this item is to determine if the stream riparian plants are healthy and robust, or are in a weakened/stressed state and leaving the area. As riparian plants weaken or leave an area the reach is subject to degradation.

For Cold Creek the riparian plant community is severely stressed.

Yes	No	N/A	10. Riparian-Wetland Plants Exhibit High Vigor.
	X		Stressed from Consistent Grazing.

6. Adequate Riparian-Wetland Vegetative Cover Present to Protect Banks and Dissipate Energy During High Flows. *[Enough?]*

Normal channel migration is essential for creating and maintaining a variety of aquatic and riparian habitats (Prichard et al., 1998). To prevent excessive erosion is to have adequate vegetative cover to dissipate the erosive forces acting on the channel. Therefore, the benefit of riparian vegetation is its ability to filter sediments, dissipate flow energy (i.e., create slow velocity zones), aid flood plain development and storage of water, and protect stream banks, which is crucial in obtaining proper functioning condition.

Maintenance and recovery of a riparian wetland area is dependent on the having the "right plants", recruitment, and the "right amount" to achieve its potential function.

The objective of this item is to determine if there is an adequate "amount" of vegetation present to dissipate stream energies from high-flow events.

Cold Creek vegetative cover is lacking. Riparian vegetation only covers approximately 5-10%. Impacts appear to be related to flooding, horse and wildlife grazing and some recreational activity.

Yes	No	N/A	11. Adequate Riparian-Wetland Vegetative Cover Present to Protect Banks and Dissipate Energy During High Flows. *[Enough?]*
	X		**Vegetative Cover is Between Approximately 5 - 10% of the Riparian Area.**

7. Plant Communities are an Adequate Source of Coarse and/or Large Woody Material (for Maintenance/Recovery).

Stream riparian continuum is in a state of dynamic stability when it is functioning properly (Prichard et al., 1998). Large woody material (LWM) plays a prominent role in regulating channel morphology, habitat and dissipation of energy. Woody material helps create physical habitat diversity, fish cover, pool development, and undercut banks. LWM is recruited as part of natural channel migration (e.g., bank erosion, landslides, etc.).

The objective of this item is to determine if woody material essential for system, and if necessary, is the woody material present in size and number.

For Cold Creek, large woody material (LWM) is essential for the stream to reach its potential. This reach is missing willow recruitment.

Yes	No	N/A	12. Plant Communities are an Adequate Source of Coarse and/or Large Woody Material (for Maintenance/Recovery).
	X		**Missing Willow Crowns.**

6.5 Erosion Deposition

Stream channels are constantly in motion adjusting to fluxes in stream flow and sediment being supplied by the watershed (Prichard et al., 1998). Items 13 - 17 deal with the erosion and deposition attributes and processes necessary for a system to function properly.

13. Floodplain and Channel Characteristics (i.e., Rocks, Overflow Channels, Coarse and/or Large Woody Material) Adequate to Dissipate Energy.

Channel and floodplain characteristics will vary depending on channel type (Rosgen, 1996). For stream riparian systems to function properly, flow energy has to be dissipated during high-flow events (Prichard et al., 1998; Rosgen, 1996). In a functioning system, energy is reduced through floodplain access and channel characteristics which creates resistance to downstream movement (Prichard et al., 1998).

The objective of this item is to determine if the channel characteristics are adequate to dissipate stream energy.

There are rocks in the Cold Creek channel, but it is unvegetated and narrow.

Yes	No	N/A	13. Floodplain and Channel Characteristics (i.e., Rocks, Overflow Channels, Coarse and/or Large Woody Material) Adequate to Dissipate Energy.
	X		Unvegetated and Narrow in Places.

14. Point Bars are Revegetating with Riparian-Wetland Vegetation.

Lateral movement and formation and extension of point bars is part of the natural depositional process for some stream channel types. Point bars are predominant in Rosgen C channel types (Rosgen 1996). It is important vegetation colonizes the deposits as they extend over time to maintain balance (Prichard et al., 1998). If vegetation cannot maintain a balance, high flow events will accelerate erosional processes, which can result in degradation of the stream riparian system (Prichard et al., 1998). To achieve balance, the right riparian wetland plants need to have root masses capable of withstanding high stream flow events.

The objective of this item is to establish the riparian plant communities are capturing recent depositional events on point bars and maintaining the natural balance of the stream system.

For Cold Creek, stabilization of point bars is generally inadequate. To clarify. #9 above states colonizing bluegrass is the dominant species. The flood probably scoured things out but bluegrass may recolonize if it has not already.

Yes	No	N/A	14. Point Bars are Revegetating with Riparian-Wetland Vegetation.
	X		No Vegetation or Bluegrass.

15. Lateral Stream Movement is Associated with Natural Sinuosity.

Lateral stream movement usually occurs through bank erosion and point bar development (Prichard et al., 1998), and is associated with natural sinuosity. "Natural" rates of channel migration will vary by stream type and available material (Prichard et al., 1998; Rosgen 1996).

The objective of this item to is to determine if the active channel is slowly progressing across its valley floor. Excessive lateral movement will impact the overall function of the riparian area.

In Cold Creek, grazing and recreational activity is impacting the streams ability to migrate within the valley floor.

Yes	No	N/A	15.	Lateral Stream Movement is Associated with Natural Sinuosity.
	X			Building of Point Bars on Step Treads and Accelerated Erosion from Incision.

16. System is Vertically Stable. *[Not Downcutting]*

Natural streams transport water, sediment and other material out of the watershed. Natural disturbances or anthropogenic activities will impact the equilibrium conditions of the stream channel. Processes of degradation and aggradation may result in bank instability and changes in channel pattern (Prichard et al., 1998). During basin wide adjustments, the stage of channel evolution will usually vary systematically (Prichard et al., 1998). The lack of a systematic relation between stage of channel evolution and distance upstream/downstream indicates that the stability problems are local in nature (Prichard et al., 1998). For example, redirection of flow caused by a structure.

The objective of this item is to document if the channel adjustments are occurring at a "natural" or an accelerated rate.

Cold Creek is not vertically stable. Even though there are large boulders present, there are many headcuts (nick points) throughout the reach.

Yes	No	N/A	16.	System is Vertically Stable. *[Not Downcutting]*
	X			Heading (Nick Points) in Many Places.

17. Stream is in Balance with the Water and Sediment Being Supplied by the Watershed (i.e., No Excessive Erosion or Deposition).

As streams transport water and sediment out of a watershed any excessive erosion or deposition indicates the system is out of balance with the material being supplied.

The objective of this item is to identify if the riparian wetland area is out of balance with the stream flow and material being supplied.

Cold Creek is not in balance with the material being supplied with excessive deposition of fine grained material.

Yes	No	N/A	17. Stream is in Balance with the Water and Sediment Being Supplied by the Watershed (i.e., No Excessive Erosion or Deposition).
	X		Too Much Energy and Incision with Some in Peak Flow Deposits.

6.6 *Functional Rating*

Nonfunctional. It may be too early from flood event to note any improvement. Middle to lower end of the thermometer. Yes – Flow regulation (diversion at the top of the reach), other – urbanization and political issues related to uncontrolled horse population.

6.7 *Lentic Checklist – Cold Creek Fire Station Ponds*

Fluvial processes of sediment transport and storage are directly related to stream and wetland riparian habitat dynamics (Hurley and Jensen, 2001). The PFC checklist is designed to address the common attributes and processes needing to be in working order for a lentic riparian-wetland area to function properly.

Figure 25. Cold Creek Fire Station Maintained Pond and Wetland Area Resulting from the Unlined Channel.

6.8 *Hydrology*

The term "wetland hydrology" encompasses all hydrologic characteristics of wetland areas that are periodically inundated, or has soils saturated to the surface at some time during the growing season (Prichard, et al., 1999). Inundated, or saturated, to the surface for sufficient duration to develop hydric soils (i.e., anaerobic soil conditions) and support vegetation adapted to anaerobic soil conditions (Prichard, et al., 1999).

Hydrology is often the least exact of the parameters. It is essential to establish that a wetland area is periodically inundated or has saturated soils during the growing season (Prichard et al. 1994).

Item 1: Riparian-Wetland Area is Saturated at or Near the Surface or Inundated in "Relatively Frequent" Events

Water creates and maintains all wetlands. Water is the dominant factor determining the nature of soil development and the plant community structure in a wetland (lentic) system (Cowardin et al., 1979). The purpose of Item 1 is to document the wetland is inundated (i.e., saturated) long enough in duration and occurs frequently enough to maintain wetland characteristics.

Yes	No	N/A	Item 1: Riparian-Wetland Area is Saturated at or Near the Surface or Inundated in "Relatively Frequent" Events.
X			But, Not to Margins of Organic Rich Soil.

Item 2: Fluctuation of Water Levels is Not Excessive

Periodic flooding, or saturation, of the wetland areas is necessary to promote and sustain OBL and FACW vegetation. Water level changes must be within the range of plant tolerance. The purpose of Item 2 is to determine if the water level changes are within the limits capable of sustaining riparian-wetland vegetation.

Yes	No	N/A	Item 2: Fluctuation of Water Levels is Not Excessive.
X			Ponds are Supplied by a Perennial Flow, but Monsoonal Weather Patterns Can be Very Episodic.

Item 3: Riparian-Wetland Area is Enlarging or has Achieved Potential Extent

Depending on a lentic area's site characteristics, degradation can result in accelerated sedimentation (filling in faster), or loss, or lowering, of the water table (Prichard, et al., 1999). Either process will have a detrimental effect on the riparian-wetland vegetation and community structure. A loss, or lowering, of the water table results in loss of vegetation vigor (i.e., water stress), lowered production, and eventually a complete loss of riparian-wetland vegetation (Prichard et al., 1999). The objective of Item 3 is to determine if the riparian wetland area is degrading, recovering or has recovered.

For Cold Creek ponds, excessive sediment from the parking area is resulting in a decrease in the spatial extent of the wetland as the perimeter area shrinks with declining catchment capacity (Figure 16 – 20 & 25). Recreation use and horses are the primary impacts to the Riparian Area.

Yes	No	N/A	Item 3:	Riparian-Wetland Area is Enlarging or has Achieved Potential Extent.
	X			Digging a Channel Sped Up Water, Which is Preventing the Wetland Area Reaching Potential.

Item 4: Upland Watershed is Not Contributing to Riparian-Wetland Degradation

The objective of Item 4 is to determine if the surrounding uplands are affecting the condition of a riparian-wetland area. Alteration in upland condition influences the magnitude, timing, or duration of overland flow events (Prichard et al., 1999). This in turn affects the riparian wetland functionality. The focus is on whether the uplands are, or are not, contributing to degradation, and not on the condition of the uplands. Water is being supplied from Cold Creek.

Yes	No	N/A	Item 4:	Upland Watershed is Not Contributing to Riparian-Wetland Degradation.
X				Diversion Augmenting Flow into the Ponds and Wetland Area.

Item 5: Water Quality is Sufficient to Support Riparian-Wetland Plants

The purpose of Item 5 is to determine if water quality is being maintained (Prichard et al., 1999). The toxicological impacts to an ecosystems occurs when there is too low or too high nutrient and trace metal concentrations. The effect also occurs for sediment. For example, nutrient (i.e., nitrogen, phosphorus) concentrations exceed the capability of the wetland vegetation community to absorb them, and or the concentrations are too low to maintain vigor. Maintenance of water quality is important for riparian wetland areas to produce the kind of vegetation necessary for proper functioning condition.

Yes	No	N/A	Item 5:	Water Quality is Sufficient to Support Riparian-Wetland Plants
X				Nutrient Levels are Not Impacting Riparian Community and is Adequate to Maintain a Carp/Trout Fishery.

Item 6: Natural Surface or Subsurface Flow Patterns are not Altered by Disturbance (i.e., Hoof Action, Dams, Dikes, Trails, Roads, Rills, Gullies, Drilling Activities)

If the natural surface or subsurface flow patterns of lentic areas are altered, the timing, frequency, magnitude, and duration of inundation or saturation can be affected, with corresponding changes to the soils and vegetation (Prichard et al., 1999). This would indicate that the wetland plant community may be impacted during drought conditions, which is suggested in Items 10-12.

The objective of Item 6 is to determine if surface or subsurface flow patterns are being maintained. A change in flow patterns may mean a change in vegetation type (e.g., wetland species to upland species). Alteration of surface or subsurface flow patterns may affect the functionality of a site, by creating a site unable to dissipate energies and function properly.

Field observations indicated that surface flow patterns are altered/constructed. As seen in Figure 16 – 20 and 25, indicates that the surface flow is a dug trench, pond has a dam with horse trails, there are rills coming off the parking area, and hoof action from wild horses.

Yes	No	N/A	Item 6: Natural Surface or Subsurface Flow Patterns are not Altered by Disturbance (i.e., Hoof Action, Dams, Dikes, Trails, Roads, Rills, Gullies, Drilling Activities).
	X		Dug Channel/Trenching.

Item 7: Structure Accommodates Safe Passage of Flows (e.g., No Headcut Affecting Dam or Spillway)

Some lentic riparian-wetland areas have been altered through the addition of structures designed to capture more runoff, thus creating a more permanent or larger wetland (Prichard et al., 1999). When structures are placed to alter a riparian-wetland area, it is very important that the structure is designed and maintained to accommodate safe passage of flows (Prichard et al., 1999). The purpose of Item 7 is to determine if these structures are accommodating safe passage of flows.

As seen in Figure 9, hoof action is impacting the dam. Without more rock or stabilizing plant communities a high rainfall event will impact spillway and dam.

Yes	No	N/A	Item 7: Structure Accommodates Safe Passage of Flows (e.g., No Headcut Affecting Dam or Spillway).
	X		Neither Stabilizers or Rock on Spillway and Horses will Likely Send Water Over Dam.

6.9 Vegetation

Items 8-15 address vegetation attributes and processes that should be in working order for a lentic riparian-wetland system to function properly (Prichard et al., 1999). In assessing functionality, the whole complex (i.e., landform, vegetation community structure) should be considered in order to understand such items as age class distribution and species diversity. For a wetland area to persist or improve, the plant species or communities of interest must be both healthy (vigorous) and replacing or increasing their numbers or extent through recruitment into the community. The site should be evaluated by determining if the right kinds and proportions of species of community vegetation types are those found in lentic riparian-wetland areas (Prichard et al., 1999). For example, many lentic riparian-wetland areas do not have the soil and hydrology conditions needed to support tree or shrub species.

Riparian-wetland plants are classified into five types based on the likelihood of their occurrence in wetlands or non-wetlands (Reed 1988). These classes are: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), and obligate upland (UPL). OBL species are likely to occur in wetlands >99 percent of the time, whereas FACW species occur in wetlands between >67-99 percent of the time. The FAC species are likely to occur in wetlands 33-67 percent of the time;

FACU species are likely to occur 1-<33 percent of the time. UPL species almost never (<1 percent) occur in wetlands.

Item 8: There is Diverse Age-Class Distribution of Riparian Wetland Vegetation (Recruitment for Maintenance/Recovery)

In most cases, a riparian-wetland area should have more than one age class of wetland plants present for maintenance and/or recovery – i.e., a sufficient number of age classes are present to provide recruitment to maintain an area or to allow an area to recover (Prichard et al., 1998). Most riparian-wetland areas can maintain their numbers with two age classes. Provided one of the age classes is young for recruitment, and the other is middle aged (i.e., replacement). Older/mature age classes are well attached to existing water tables and can persist even with degraded conditions (Prichard et al., 1998). Most herbaceous riparian wetland plants spread vegetatively (Prichard et al., 1999). A lack of spreading by wetland plants may indicate a lack of age class diversity. This is possibly due to a change in site conditions.

The objective of Item 8 is to determine the age class distribution of at least one to two species of plants.

For Cold Creek, ponds there were very little young plant communities.

Yes	No	N/A	Item 8:	There is Diverse Age-Class Distribution of Riparian Wetland Vegetation (Recruitment for Maintenance/Recovery).
	X			Little or No Examples; Lack of Young Willow. Rush Present, but Very Little.

Item 9: There is Diverse Composition of Riparian-Wetland Vegetation (for Maintenance/Recovery)

In addition to diverse age-class distribution, diverse species composition is important for maintenance and recovery (Prichard et al., 1998; Prichard et al., 1999). The objective of Item 9 is to determine and document if the existing species composition is sufficient for maintenance or recovery. Basically, two or more riparian-wetland species are present, but varies by the potential of the site to support a given number of species. Site characteristics can give a competitive advantage of a particular species over other species. Capability of the site to support multiple riparian-wetland species must also be considered (Prichard et al., 1999). If the hydrology has been altered by some activity in the upper watershed, altered flows into the wetland may limit the types of species that can survive (Prichard et al., 1999).

For this wetland area, there is a diversity of vegetation community predominantly in the herbaceous and woody material.

Yes	No	N/A	Item 9: There is Diverse Composition of Riparian-Wetland Vegetation (for Maintenance/Recovery).
X			Rushes, Sedges and Willows.

Item 10: Species Present Indicate Maintenance of Riparian Wetland Soil Moisture Characteristics

Plants occurring in riparian wetland areas are hydrophytes (Prichard et al., 1998). They have to be in contact with the water table. The intent of Item 10 is to look for those species indicating the presence of a shallow water table. For example, ovate spike rush (OBL) and rabbit-foot grass (FACW), may indicate maintenance of the water table in the absence of deep rooted perennials. This depends on how degraded the area appears and the types of species present.

A functional riparian system will have obligate wetland (OBL – e.g., cattails, Baltic rush, pondweed, etc.) or facultative wetland (FACW – spiked rush, ferns, etc.) plant communities on a perennial reach. A “no” response for this question will be given if facultative upland or upland (drier site plants) dominant the reach.

For the entire wetland area, riparian plant species present indicates the presence adequate soil moisture (Figure 9).

Yes	No	N/A	Item 10: Species Present Indicate Maintenance of Riparian Wetland Soil Moisture Characteristics.
X			Arroyo Willow, Fremont Cottonwood, Black Willow, Sedge, Rush, Rosa Woodsii.

Item 11: Vegetation is Comprised of Those Plants or Plant Communities that have Root Masses Capable of Withstanding Wind Events, Wave Flow Events, or Overland Flows (e.g., Storm Events, Snowmelt)

Lentic riparian-wetland areas can have open water, or wet meadows with standing water some part of the year. The objective of Item 11 is to determine if the shorelines/soil surfaces have the right plants, or community types, present and in abundance to protect the riparian-wetland area from erosion – i.e., those species with root systems capable of withstanding such events (Prichard et al., 1998; Prichard et al., 1999).

Most perennial plants that are OBL and FACW have root masses capable of withstanding erosional events, while most FACU and UPL plants do not (Prichard et al., 1999). Typically, herbaceous species with rhizomes, or stolons, which form a continuous mat of roots (rather than isolated individual bunch grasses) are most effective (Prichard et al., 1999).

For this site, willows dominant the periphery of the wetland with some annuals which have been grazed.

Yes	No	N/A	Item 11: Vegetation is Comprised of Those Plants or Plant Communities that have Root Masses Capable of Withstanding Wind Events, Wave Flow Events, or Overland Flows (e.g., Storm Events, Snowmelt).
X			Willows.

Item 12: Riparian-Wetland Plants Exhibit High Vigor

The objective of Item 12 is to determine if the stream riparian plants are healthy and robust, or are in a weakened/stressed state and leaving the area. As riparian plants weaken or leave an area, the wetland is subject to degradation. The aboveground expression is a reflection of the condition of the root system and the ability of riparian-wetland species to hold an area together (Prichard et al., 1999). During the growing season, plant size, shape and leaf color can be used to discern vigor (i.e., robustness, health).

For this wetland, the riparian herbaceous plant community is heavily grazed.

Yes	No	N/A	Item 12: Riparian-Wetland Plants Exhibit High Vigor.
	X		Fenced Area Now a Pasture, Grazing Still a Stressor.

Item 13: Adequate Riparian-Wetland Vegetative Cover is Present to Protect Shoreline/Soil Surface and Dissipate Energy During High Wind and Wave Events or Overland Flows

Vegetation filters sediment, aids floodplain development, protects shorelines, etc., all of which dissipate energies associated with wind action, wave action, and overland flow events. The purpose of Item 13 is to determine if there is an adequate amount of vegetation present to dissipate energies from these events (Prichard et al., 1999).

For a riparian wetland area to maintain/recover, composition and abundance of the right plants, recruitment, etc., are necessary/essential for the system to function properly (Prichard et al., 1998; Prichard et al., 1999).

For this wetland, there is ‘not’ an adequate vegetative cover. However, flash flooding and inputs of excessive sediment from the parking area can be destructive.

Yes	No	N/A	Item 13: Adequate Riparian-Wetland Vegetative Cover is Present to Protect Shoreline/Soil Surface and Dissipate Energy During High Wind and Wave Events or Overland Flows.
	X		Pond Perimeter is Not Completely Vegetated.

Item 14: Frost or Abnormal Hydrologic Heaving is Not Present

The objective of Item 14 is to determine if frost or hydrologic heaving is occurring, and determine if it is occurring at a normal or aggravated rate. Frost or hydrologic heaving occurs when soil pores contain free water conducive to the development of segregated ice lenses or crystals and when temperatures drop below freezing (Prichard et al., 1999). Needling occurs when soil water is brought to the surface via capillary action, where it freezes and contributes to a growing needle-like ice column.

This is a natural process which is aggravated by impacts that either seal parts of the surface, which restricts water infiltration between plants, or reduces pore space by compaction between plants (Prichard et al., 1999). Excessive removal of vegetation, acting as thermal cover, can exaggerate the effects of freezing resulting in vegetated hummocks (i.e., increasing elevation develops between the sealed or compacted interspaces).

Yes	No	N/A	Item 14: Frost or Abnormal Hydrologic Heaving is Not Present.
X			Needling Present, but not Hummocks.

Item 15: Favorable Microsite Condition (i.e., Woody Material, Water Temperature, etc.) is Maintained by Adjacent Site Characteristics

The objective of Item 15 is to determine if microsite conditions are necessary for proper functioning, and if the adjacent site characteristics are maintaining those conditions. Some riparian-wetland areas require very specific conditions to sustain temporal water budgets (Prichard et al., 1999). If seasonal inflows, outflows, and/or evapotranspiration characteristics are significantly altered, the type and extent of the riparian-wetland area can also be altered. Adjacent site characteristics can directly influence both inflow and outflow by buffering surface runoff (Prichard et al., 1999).

Changes in vegetation type and abundance can change the evaporation to transpiration rate. In some riparian-wetland areas, adjacent site characteristics can affect vegetation recruitment potential on-site by shading, temperature modification, available seed germination sites, etc. (Prichard et al., 1999). If functionality is dependent on these particular species, then the adjacent site characteristics must also be maintained (Prichard et al., 1999).

For this reach, microsites are not present – N/A.

Yes	No	N/A	Item 15: Favorable Microsite Condition (i.e., Woody Material, Water Temperature, etc.) is Maintained by Adjacent Site Characteristics.
		X	

6.10 Erosion Deposition

Wetland riparian habitats are constantly in motion adjusting to fluxes in stream flow and sediment being supplied by the watershed (Prichard et al., 1998). Items 16-20 deal with the erosion and deposition attributes and processes necessary for a system to function properly.

Item 16: Accumulation of Chemicals Affecting Plant Productivity/Composition is Not Apparent

Maintaining a chemical balance of essential trace metals and nutrients in a lentic riparian-wetland area is necessary to maintain functionality. Toxic effect to plant communities occurs if there is an imbalance in the water and soil chemistry of essential nutrients and trace metals, and an increase of organic chemicals (i.e., herbicides, pesticides, etc.). Accumulation of harmful chemicals can potentially affect plant and soil microbial composition and/or productivity (Prichard et al., 1999). The objective of Item 16 is to determine if the vegetation is being affected by chemicals.

Yes	No	N/A	Item 16: Accumulation of Chemicals Affecting Plant Productivity/Composition is Not Apparent.
X			Yes. Not apparent.

Item 17: Saturation of Soils (i.e., Ponding, Flooding Frequency, and Duration) is Sufficient to Compose and Maintain Hydric Soils

The objective of Item 17 is to determine whether hydric soils are being created or maintained in areas that should have hydric soils. Hydric soils are developed and maintained through frequent flooding, ponding, or saturation for a long enough time for anaerobic conditions to develop (Prichard et al., 1999).

It is difficult to determine if the current drought condition is impacting the wetland because of the diverted water from Cold Creek.

Yes	No	N/A	Item 17: Saturation of Soils (i.e., Ponding, Flooding Frequency, and Duration) is Sufficient to Compose and Maintain Hydric Soils.
X			Along Boundary of Ponds and where Seeping Through Dam. Maybe Just on the Edge of the Water, not more than 3.5 ft Away. Wetland Area Along the Dug Trench.

Item 18: Underlying Geologic Structure/Soil Material/Permafrost is Capable of Restricting Water Percolation

The objective of Item 18 is to identify whether geologic structure and/or underlying soil material is being maintained. Lentic, or standing water, riparian-wetland areas often have an underlying soil material/type capable of maintaining, or persisting over long periods of time. For example bedrock, clay layer, or caliche which is a hardened deposit of calcium carbonate, which creates a bowl effect. This underlying material restricts water percolation, producing permanent or seasonal ponding, saturation, or inundation (Prichard et al., 1999). This underlying material has to be maintained for an area to function properly. If the underlying bowl (i.e., impervious layer) is breached the wetland area can no longer hold water thus maintaining existing hydrology and associated vegetation.

Yes	No	N/A	Item 18: Underlying Geologic Structure/Soil Material/Permafrost is Capable of Restricting Water Percolation.
X			Ponds are Able to Maintain Holding Capacity.

Item 19: Riparian-Wetland is in Balance with the Water and Sediment being Supplied by the Watershed (i.e., No Excessive Erosion or Deposition)

The purpose of Item 19 is to identify if water and sediment are being supplied to the wetland at a natural rate for the system to maintain or improve functions. Over geologic time, lentic riparian-wetland areas will follow a natural successional process of fill with sediment and converting to an upland area type (Prichard et al., 1999). This conversion/successional change can be accelerated by activities within a watershed, such as road building, logging, water diversions, farming, or grazing, if not done properly (Prichard et al., 1999). Too many roads, roads in the wrong location, or roads constructed in a manner to channelize stream conditions may accelerate erosion within a watershed. This erosion may result in excessive amounts of sediment being supplied to a riparian wetland area, filling it faster (Prichard et al., 1999) and decreasing its function potential. If flows increase, or have been increased by construction activity (Figure 9), the resulting increased energy will form headcuts (incision) endangering the entire system (Figure 9). The increased flows and increased sediment load will change the type of riparian-wetland (i.e., marsh to lake) system (Prichard et al., 1999).

As seen at this site, construction of the parking area along with continued motorized and non-motorized recreational use and trench maintenance is supplying sediment to the ponds.

Yes	No	N/A	Item 19: Riparian-Wetland is in Balance with the Water and Sediment Being Supplied by the Watershed (i.e., No Excessive Erosion or Deposition).
	X		Excessive Sediment from Parking Lot with No Vegetation in that Part of the Ponds. Question – Is the Local Fire Station Removing Vegetation for Easy Access and/or Ease of Dipping Water for Fire Fighting Efforts.

Item 20: Islands and Shoreline Characteristics (i.e., Rocks, Coarse and/or Large Woody Material) are Adequate to Dissipate Wind and Wave Event Energies

The intent of Item 20 is to address those systems that **do not** require vegetation (Prichard et al., 1999). Riparian-wetland areas with islands and shorelines have to be able to dissipate energy during wind action and wave action events to function properly (Prichard et al., 1999). Islands and shorelines need characteristics to dissipate wind and wave action. Presence of rocks, woody and/or herbaceous material will dissipate energies associated with wind and wave action.

For this wetland assessment area this Item is Not Applicable (N/A).

Yes	No	N/A	Item 20: Islands and Shoreline Characteristics (i.e., Rocks, Coarse and/or Large Woody Material) are Adequate to Dissipate Wind and Wave Event Energies.
		X	

6.11 Functional Rating

Functional – At Risk (FAR). The **Trend for Functional – At Risk** is **Downward**. On the PFC thermometer, this site is FAR just above Nonfunctional.

Factors contributing to unacceptable conditions are outside the control of the site manager (No).

Are factors contributing to unacceptable conditions within the control of the manager? (Yes) – Horses, enclosed wetland area, and multiple conflicting use of ponds.

7.0 Discussion

When determining whether a riparian-wetland area is functioning properly, the condition of the entire watershed, including the uplands and tributary watershed system, is important. The entire watershed can influence the quality, abundance, and stability of downstream resources by controlling production of sediment and nutrients, influencing streamflow, and modifying the distribution of chemicals throughout the riparian-wetland area. Riparian-wetland health (functioning condition), an important component of watershed condition, refers to the ecological status of vegetation, geomorphic, and hydrologic development, along with the degree of structural integrity exhibited by the riparian-wetland area. A healthy riparian-wetland area is in dynamic equilibrium with the streamflow forces and channel aggradation/degradation processes producing change with vegetative, geomorphic, and structural resistance. In a healthy situation, the channel network adjusts in form and slope to handle increases in stormflow/snowmelt runoff with limited perturbation of channel and associated riparian-wetland plant communities.

Prichard et al., 1999, state, "When adequate vegetation, landform, or large woody debris is present to dissipate energy associated with high flows, then a number of physical changes being to occur, such as reduced erosion, sediment filtering, and improved habitat for fish, water-fowl, and other uses. The physical aspects have to be in working order to sustain the channel characteristics that provide the habitat for these resource values. For areas that are not functioning properly, changes have to be made that allow them to recover (e.g., acquire adequate vegetation). A change such as acquiring vegetation leads to other physical changes, which allows the system to begin to function. Recovery starts with acquiring the right element(s) to dissipate energy, which puts the physical process into working order and provides the foundation to sustain the desired conditions."

For the Cold Creek area, there are several politically driven reasons (horse, wildlife, fire fighting) that the community, including the USFS, will need to work as a group to deal with if the community wants to improve the functional status of the Cold Creek water resources. The land owner living on the down stream portion of the creek told us that the land owners up stream need to increase their interest in the condition of the down stream area. Up stream owners want to continue the land use practices of hiking, horse and vehicle pathways along the stream bank. Wild horses and wildlife (elk) also use this area for water. Up stream owners should be informed of the current non functional status of the down stream portion of the creek so that land management decisions can be modified to include both pathways and a better functioning condition. It is our observation that this ecosystem can make a full recovery if managed for properly functioning condition.

It was unclear if residents of Cold Creek were concerned about the wetland area. Certainly the Forest Service and Fire Department were very concerned. Should the constructed ponds be used and maintained as abiotic for the Fire Department to make it easier to siphon the water and for stock and possible wild horse watering (Figure 26). There was a certain amount of vegetation allowed on the earthen dams to provide some support (via roots), and habitat for recreational fisheries. If the current management plan includes all of these uses then condition of the ponds will never be better than functional at risk.

However, for Cold Creek, this type of management plan has a larger management issue. The headcuts may impact the spring itself, compromise housing and streets located up stream and jeopardize the communities fresh water resource.

8.0 Conclusions and Recommendations

The primary objective of providing Tribes with PFC training was met. Hosting a water resource training workshop in the Mojave Desert is challenging. Many of the participants did come from dry land regions so this was a good demonstration of how to conduct a PFC Workshop in areas they would normally encounter on Tribal lands. Participant evaluations were positive and they clearly indicated that more field time was highly recommended. We would recommend that each participating Tribe consider conducting a PFC Workshop on their Tribal lands. Tribal members who are land managers, environmental specialists and council members who attend a PFC Workshop would become well versed in PFC methods. Each Tribe can then start PFC assessments geared to meet water quality standards which will be cost effective and meet Tribal goals and values. The authors will render any and all assistance to facilitate Tribal lands PFC workshops in the future.

A secondary objective presented itself when we selected Cold Creek, Nevada for a training site. We observed an ecosystem on the verge of collapse. The natural riparian resources of vegetation, soil/landform and water quality were compromised. Because of land use practices upstream, water was not held on the landscape during a large storm event which overwhelmed downstream resources. This caused a head cut downstream which now poses a threat to upstream property in any future major events. The primary principal of cooperative riparian restoration is “healthy streams through bringing people together.” As stated in the PFC training, “Restoration will not happen by regulation, changes in the law, more money or any of the normal bureaucratic approach. It will only occur through the integration of ecological, economic and societal factors, and participation of (all) affected interests.” Do not ascribe blame. Work together. Move forward. No one is telling anyone what to do. By bringing together the right people, in constructive ways, with good information, they will produce better decisions, improved relationships and sustainable communities and landscapes.

Use of the flood plain and stream banks by foot traffic, horses and all terrain vehicles took its toll on the creek. Presence of wild horses and wildlife within Cold Creek and ponds indicate pathogens may be an issue of concern. Best management practices identified to mitigate and/or eliminate for non-point source pollutants include:

(1) Educating the public about waterbody health.

(2) Implementing creek bank protection.

(3) Commence riparian vegetation improvement through managing horses and wildlife, and/or through revegetation.

(4) Maintain and restore the hydrologic connectivity of streams, meadows, wetlands.

The U.S Forest Service and the Bureau of Land Management are the best partners anyone could ask for in efforts to restore water resources. Both agencies have a proven track record of success in restoration. The initiative for accelerating cooperative riparian restoration and management was created in 1996 by BLM and the US Forest Service in partnership with the National Resource Conservation Service. Working together for creeks and communities will empower people to create change.

Figure 26. Photographs of Wild Horses in the Cold Creek Watershed. Photographs taken by John Lin & Tad Harris.

9.0 References

Alexander, Jan, and Marriott, Susan B., 1999, Geological Society, London, Special Publications, *Geological Society, London, Special Publications,* v. 163; p. 1-13 doi:10.1144/GSL.SP.1999.163.01.01

Hurley, Michael, and Jensen, Mark E., 2001, Geomorphic Patterns, Processes, and Perspectives in Aquatic Assessments, in A Guide Book for Integrated Ecological Assessments, Jensen, Mark E., and Bourgeron, Patrick S., editors, Springer Verlag, 536 pages.

Prichard, Don, Barrett, Hugh, Gebhardt, Karl, Cagney, Jim, Hansen, Paul L., Clark, Ron, Mitchell, Brenda, Fogg, Jim, Tippy, Dan, 1993, Riparian Area Management: Process for Assessing Proper Functioning Condition, U.S. Department of the Interior, Bureau of Land Management, Technical Reference 1737-9, 1993; Revised 1995, 1998.

Prichard, Don, Berg, Forrest, Hagenbuck, Warren, Krapf, Russ, Leinard, Robert, Leonard, Steve, Manning, mary, Noble, Chris and Staats, Janice, 1996, Riparian Area management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas, Technical Reference 1737-16, 1999; Revised 2003, U.S. Department of the Interior, Bureau of Land Management.

Prichard, Don, Anderson, John, Correll, Cindy, Fogg, Jim, Gebhardt, Karl, Krapf, Russ, Leonard, Steve, Mitchell, Brenda and Staats, Janice, 1998, Riparian Area Management, A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas; Technical Reference TR1737-15, Department of the Interior, Bureau of land Management (BLM).

Prichard, D., P. Clemmer, M. Gorges, G. Meyer, and K. Shumac. 1999. Riparian Area Management: Using Aerial Photographs to Assess Proper Functioning Condition of Riparian-Wetland Areas. TR 1737-12. Bureau of Land Management, BLM/RS/ST-96/007+1737, National Business Center, CO. 37 pp.

Schmudde, T. H. 1968. Floodplains. *In:* FAIRBRIDGE, R. W. (ed.) *The Encyclopedia of GeomorphoIogy.* Reinhold Book Corporation, New York, 359-362.

Appendix 1 – Workshop Announcement

Tribal Ecosystem Research Program (TERP) Workshop

Proper Functioning Condition (PFC) Assessment for Management and Monitoring

- Interested in understanding why your waterway looks the way it does?
- Can you explain how climate changes affect the health of a riparian area?
- Do you need to know how to restore your stream and wetland riparian ecosystem?
- Need to determine and define a successful and effective restoration project?
- Are you measuring/monitoring the right indicators?

Workshop/training – ***PFC Assessment for Management and Monitoring*** – will teach you how to use the concept of Proper Functioning Condition to both assess and improve the condition of streams and wetlands. You don't have to be a tech-head biologist/hydrologist to understand the procedures in this workshop. This is a great opportunity for anyone with an interest in the health of our nation's waterways and wetlands to learn the techniques required for assessment and restoration.

The objective of this three day workshop ***(March 18-20, USEPA ORD Laboratory, 944 East Harmon Ave., Las Vegas, NV 89119, which is on the University of Nevada, Las Vegas campus)*** is to explore the feasibility and utility of focusing on an ecosystem services science approach for adaptive management and decision making in natural resource and environmental programs (e.g., USEPA CWA 106, 319, TMDL, WQS).

If the science isn't enticing enough to join us at this workshop, how about - If you've had a cold wet dreary winter, come to Las Vegas and have some fun in the sun playing in streams and wetlands. If you haven't had a dreary winter, you'll have to settle for some most excellent science.

To Sign Up or Ask Questions, Please Contact:

John, Lin, U.S. EPA ORD
lin.john@epa.gov – (702-798-2171)

Or, Daniel Heggem, U.S. EPA ORD
heggem.daniel@epa.gov – (702-798-2278)

Instructors from the Nevada Creeks and Community Team. Workshop is sponsored by EPA ORD/NERL/ESD Landscape Ecology Branch.

Also, visit our website at http://www.epa.gov/nerlesd1/terp/

Upcoming Workshop Description:

Hosted by: USEPA Office of Research & Development and USEPA Region 9

This Workshop is FREE to all Tribes and Tribal Members

When?

Tuesday March 18, 2014 to Thursday March 20, 2014
Workshop runs from 8am to 5:00pm

Where?

US EPA Office of Research & Development Executive Offices
994E. Harmon Rd., Las Vegas, NV 89119

Field Sites: Cold Creek (Lentic) Area, and Cold Creek and Las Vegas Wash (Lotic).

****Note*: *Please Dress Appropriately for Field Sites*** *(Sneakers, Hats, Comfortable Clothing)****

Who is this Workshop Geared Toward?

Ecosystem services are a result of ecological processes producing environmental resources. Objective is to explore through ecological function process the feasibility and utility of incorporating an ecosystem science approach in adaptive management and decision making in Tribal resource programs.

Outcome is to identify potential partners and pilot studies designed to assess the function and condition of ecosystems to quantify the derived goods and services. Literature, data, models and necessary background information developed for and during this workshop will be used to support Tribal Ecosystem Service (ESS) studies. Data will be assembled into an electronic data browser for ready use by tribes.

Individuals Who May Be Interested in Attending:

Natural Resource Managers	Geologists	Watershed Coordinators
Environmental Staff	Botanists	Land Managers
Water Quality Staff	Ecologists	Biologists
Nonpoint Source Pollution Staff		Farmers/Ranchers with Water Resources on Property

TERP Workshop Objective:

The objective of this three day workshop is to explore the feasibility and utility of focusing an ecosystem services science approach for adaptive management and decision making in Tribal natural resource and environmental (e.g., USEPA CWA 106, 319, etc.) programs. In addition, identify Tribal research partners and pilot studies designed to assess the function and condition of ecosystems to quantify the sustainability of derived goods and services - production, assimilation and resilience (PAR). Therefore, the products from this research will be used to assist tribes in developing resource adaptive management objectives and plans, and monitoring indicators (i.e., landscape and aquatic).

(A) *Goal/Purpose*:

Purpose of the TERP research program is to address impacts to societal/cultural and monetary/nonmonetary goods and services from various environmental stressors (e.g., anthropogenic alterations, nutrient loading, etc.). The goal of this research is to understand the ecological relationships and interconnectivity between terrestrial and aquatic habitats (i.e., hydrologic systems, recognize fundamental changes to the water cycle, water quality, aquatic and terrestrial ecology, stream form and function). For example, Riparian areas and water catchments modify water quality depending on their physical functioning. Systems functioning properly capture, and temporarily store sediment and nutrients, releasing them to produce things of value to people. Resiliency of the riparian system allows them to thrive under stress from the vagaries of nature. Riparian systems at risk, as they approach a threshold, are beginning to accelerate the loss of sediment and nutrients accumulated over time. Destruction of stress absorbing structures, including riparian vegetation and floodplain access, leads to flushing water, soil organic carbon and essential nutrients, degradation in soil and community quality, and declining productivity. Loss of biomass and biotic resources, erosion of soil, and magnification of flood effects are accelerated in non-functional systems. Non-Functional systems fail to process surges from upstream inputs.

Without context or focus, ecosystems services may become all things to all people, someone else's agenda based on their values, or an agenda connected to an endpoint without the focus on functions needed to deliver it. As such, ecosystem services may fail to convey a unifying foundation (i.e., sustainability) based on those functions needed by all.

(B) *Background Information*:

Functioning landscapes deliver ecosystem services in the form of products, assimilation, and resilience (PAR). They provide ecosystem services at rates varying across landscapes, because of differences in potential and in the condition of each area to function. Wildlife and aquatic habitats as well as economic enterprises all depend on the development of a riparian and watershed management strategy that sustains ecological functions through facilitated self repair. By recognizing the value of services provided by functioning ecosystems, society becomes motivated to avoid risky, support sustainable, and facilitate restorative management.

EPA's Ecosystem Services Research Program (ESRP) in the Office of Research and Development has undertaken a comprehensive research effort to study ecosystem goods and services, and the benefits they provide to human well-being. For example, stream and wetland riparian ecosystems provide clean water, flood protection, wildlife habitat, livestock habitat and food, and human food, fuel, and fiber. These goods and services are also facing unprecedented pressures from climate change and population growth. Consequently, sustainability of basic ecosystems services vital to human health and well-being may be becoming compromised.

Tribal Ecosystem Services (ESS) studies will be conducted in collaboration with Tribes and others to determine how an ecosystem services assessment can be linked with traditional knowledge to improve natural resource management and to identify decision support options. The sustainable flow of natural resources and ecological services is required to meet the nutritional, cultural, societal and economic needs of indigenous communities. Tribes offer unique knowledge and perspectives in managing ecosystems. Understanding the linkages between traditional knowledge, locally evolved management systems, human health and well-being, and risk will enhance Tribal adaptive management program(s), the evolution of ecosystem services sciences, and further USEPA's ESRP.

(C) Field Trip - *Note: Please Dress Appropriately for Field (Sneakers, Hats, Comfortable Clothing)*

Vegetation is one of the primary ecological attributes affected by humans (i.e., grazing, urbanization, etc.), and provides indicator of succession to quantify functionality trend. The goal of the USEPA, Tribes and land management groups and agencies is to maintain and restore the goods and services of stream and wetland riparian areas. To address the aquatic impacts from environmental stressors it is important to understand the interconnectivity of a system and recognize the fundamental changes to the water cycle, water quality, aquatic and terrestrial ecology and stream form and function. Field Trip will assess stream function and biophysical alterations at a local scale to provide an example of adaptive management alternatives. The objectives of the Field Trip are:

- Define management recommendations and broad based strategies.
- Incorporate landscape and aquatic metrics into the analysis - what metrics work better than others - e.g., soil metrics, vegetation, land use, etc.
- Indicator development - identify lotic and lentic attributes appropriate for the potential or capability of the setting.
- Identify parameters to be monitored.

CALLING ALL CREEK STEWARDS!

You're Invited to Attend the Following Riparian Condition Workshop/Training

on

Riparian Proper Functioning Condition (PFC) Assessment for Management and Monitoring

at

U.S. EPA ORD Laboratory, Executive Building
944 East Harmon Ave., Las Vegas, NV 89119

Taught by the Nevada Creeks and Community Team & Sponsored by EPA ORD/NERL/ESD Landscape Ecology Branch

March 18 – March 20, 2014

What is a Riparian Area?
The banks of a river, stream, or other body of water as well as its plant and animal communities.

Primary Purpose of PFC:
To assess whether riparian-wetland areas have the water, vegetation, and land forms needed to dissipate flood energy, absorb water, stabilize banks, improve water quality, and provide habitats.

Benefits:
All participants will be trained by and alongside professional land managers specializing in biological and physical sciences vital to the health and well-being of waterways and riparian systems. Trained participants can then utilize their knowledge to assist riparian monitoring and assessment efforts.

To Sign Up or Ask Questions

Please Contact: **John. Lin**, U.S. EPA ORD lin.john@epa.gov – (702-798-2171)
Or **Daniel Heggem**, U.S. EPA ORD heggem.daniel@epa.gov – (702-798-2278)

AGENDA

U.S. EPA ORD Laboratory, Executive Building
944 East Harmon Ave., Las Vegas, NV 89119

TUESDAY, MARCH 18

8:00AM	Welcome & Introductions
8:30AM	Sustainable & Healthy Community Research
8:45 AM	PFC – What it is/Definitions/Terminology
9:15AM	Assessing Functionality – LOTIC SYSTEMS
10:00AM	BREAK
10:15AM	Assessing Functionality – LENTIC SYSTEMS
10:45AM	PFC and the Riparian Management Process
11:30AM	LUNCH on your own
12:30PM	LOTIC CHECKLIST
1:30PM	LENTIC CHECKLIST
2:00PM	Field Trip – assessment of nearby riparian area
5:00PM	Return to EPA

WEDNESDAY, MARCH 19

8:00AM	Questions & Answers from Day One
8:30AM	Application to Management
9:00AM	Field Trip to lentic and lotic sites
12:00PM	LUNCH – Please bring sack lunch
5:00PM	Return TO ESD

THURSDAY, MARCH 20

8:00AM	Questions, Discussion, Review & Feedback
9:00AM	SHC Future & Cooperative Research – e.g., Image/Photograph & Water Quality Data Analysis
10:00AM	BREAK
10:15AM	CWA Programs (e.g., 106, 319, WQS, etc.)
12:00PM	LUNCH on your own
1:00PM	Natural Condition/Catchments
2:30PM	Closing statement

To Sign Up or Ask Questions

Please Contact: **John, Lin,** U.S. EPA ORD lin.john@epa.gov – (702-798-2171)
Or **Daniel Heggem,** U.S. EPA ORD heggem.daniel@epa.gov – (702-798-2278)

Appendix 2 – Workshop Attendees

2014 TERP Workshop – EPA, Las Vegas, Nevada

NAME	EMAIL ADDRESS	ADDRESS	SLIDES
Jeanette Allogio	jallogio@blm.gov	Bureau of Land Management 4701 N. Torrey Pines Dr., Las Vegas, NV 89130	Y, Y
Sonny Elliott	environmental@cahto.org	Cahto Tribe Laytonville Rancheria 300 Cahto Drive, Laytonville, CA 95454	Y
James Hill	jhill@lptribe.net	La Posta of Diegueno Mission Indians 8 ½ Crestwood Road, Boulevard, CA 91905	Y
Fred Johnson	Navajoh2o@hotmail.com	Navajo Nation PO Box 339, Window Rock, AZ 86515	Y
Kevin Jose	Kevin.Jose@srpmic-nsn.gov	Salt River Pima-Maricopa Indian Community 1050 W. 8th Ave. , #106, Mesa, AZ 85210	Y
Corrin Liston	Cliston@blm.gov	Bureau of Land Management 4701 N. Torrey Pines Drive, Las Vegas, NV 89130	Y
Emily Luscombe	Epdes2@coyotevalley-nsn.gov	Coyote Valley Band of Pomo Indians P.O. Box 39, 7601 N. State Street, Redwood Valley, CA 95470	Y
Scott Massed	Scott.massed.a@gmail.com	4701 N. Torrey Pines Drive, Las Vegas, NV 89130	Y, Y
Javaughn Miller	jmiller@lptribe.net	La Posta of Diegueno Mission Indians 8 ½ Crestwood Road, Boulevard, CA 91905	Y
Dale Ohnmeiss	DOhnmeiss@ak-chin.nsn.us	Ak-Chin Indian Community 42507 West Peters & Nall Road Maricopa, Arizona 85138	Y,Y
Chris Pinto	ChrisPinto77@hotmail.com	Jamul Indian Village 13845 Melody Road, Jamul, CA 91935	Y
Dorothy Redhorse	Reddot_nnepa@juno.com	Navajo Nation P.O. Box 339, Window Rock, AZ 86515	Y, Y
Eric Rich	aguapuro@wildblue.net	Navajo Nation 2717 N. Steves Blvd., Ste. 2-2, Flagstaff, AZ 86004	Y

Edwin Smith	edwinsmith@brb-nsn.gov	Bear River Band of Rohnerville Rancheria 266 Keisner Road, Loleta, CA 95551	Y
Mark Valencia	mvalencia@sanmanuel-nsn.gov	San Manuel Band of Mission Indians 26569 Community Center Drive, Highland, CA 92346	Y
Linda Wimberly	water@bridgeportcolony.org	Bridgeport Paiute Indian Colony 355 Sage Brush Drive, Bridgeport, CA	Y, Y
David Wignall	dcwignall@msn.com	2825 Legend Drive, Las Vegas, NV 89134	Y
Yongping Yuan	Yuan.yongping@epa.gov	USEPA 944 E. Harmon Avenue, Las Vegas, NV 89119	Y
*Sherman Swanson	sswanson@cabnr.unr.edu	University of Nevada, Reno 1664 N. Virginia, Reno, NV 89557	Y
**Robert Hall	Hall.robertk@epa.gov	USEPA Region 9 75 Hawthorne Street, San Francisco, CA 95104	Y
**Dan Heggem	Heggem.daniel@epa.gov	USEPA ORD NERL/ESD 944 E. Harmon Avenue, Las Vegas, NV 89119	Y
*Jim Hurja	jhurja@fs.fed.us	US Forest Service Humboldt-Toiyabe NF, 4701 N. Torrey Pines Drive, Las Vegas, NV 89130	Y, Y
*Douglas Merkler	Doug.merkler@nv.usda.gov	USDA-NRCS 7080 La Cienaga Street, Ste. 150, Las Vegas, NV 89119-422	Y
*Jim Quackenboss	Quackenboss.james@epa.gov	US EPA, NERL, HEASD PO Box 93478, Las Vegas, NV 89193-3478	Y
*Robin Wignall		US Forest Service	Y

** Workshop Presenter*

***Workshop Organizer/Presenter*

Appendix 3A and 3B

Proper Functioning Condition (PFC) Lotic and Lentic Checklists

Lotic Checklist

Name of Riparian-Wetland Area:			
Date:		**Segment/Reach ID:**	
ID Team Observers:			
Potential/Capability:			

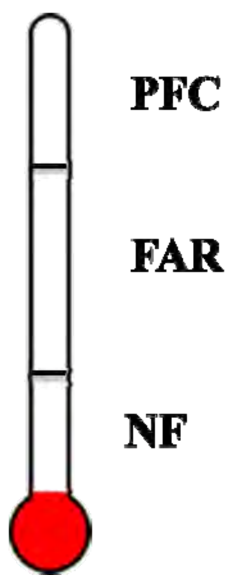
Yes	No	N/A	HYDROLOGICAL
			1) Floodplain above bankfull is inundated in "relatively frequent" events. **Notes:**
			2) Where beaver dams are present they are active and stale. **Notes:**
			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region). **Notes:**
			4) Riparian-wetland area is widening or has achieved potential extent. **Notes:**
			5) Upland watershed is not contributing to riparian-wetland degradation. **Notes:**

Yes	No	N/A	VEGETATION
			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery). **Notes:**
			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery). **Notes:**
			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics. **Notes:**
			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events. *[community types present]* **Notes:**
			10) Riparian-wetland plants exhibit high vigor. **Notes:**
			11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows *[enough?]* **Notes:**
			12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery). **Notes:**

Yes	No	N/A	EROSION DEPOSITION
			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy. **Notes:**
			14) Point bars are revegetating with riparian-wetland vegetation. **Notes:**
			15) Lateral stream movement is associated with natural sinuosity. **Notes:**
			16) System is vertically stable. [not downcutting] **Notes:**
			17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition). **Notes:**

<table>
<tr><th colspan="3">SUMMARY DETERMINATION</th></tr>
<tr>
<td>Functional Rating:
____ Proper Functioning Condition
____ Functional – At Risk
____ Nonfunctional
____ Unknown

Trend for Functional – At Risk:
____ Upward
____ Downward
____ Not Apparent

Are factors contributing to unacceptable conditions outside the control of the manager?
Yes ____ No ____</td>
<td>
</td>
<td>If yes, what are those factors?
____ Flow regulations
____ Mining activities
____ Upstream channel conditions
____ Channelization
____ Road encroachment
____ Oil Field water discharge
____ Augmented flows
____ Other (specify) ______________________

Are factors contributing to unacceptable conditions within the control of the manager?
Yes ____ No ____
If yes, what are those factors? _____________
____
____
____
______________________________________</td>
</tr>
</table>

Lotic riparian-wetland areas are considered to be in proper functioning condition when adequate vegetation, landform, or large woody debris is present to:

- Dissipate stream energy associated with high waterflow, thereby reducing erosion and improving water quality;
- Filter sediment, capture bedload, and aid floodplain development;
- Improve flood-water retention and ground-water recharge;
- Develop root masses that stabilize streambanks against cutting action;
- Develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses;
- Support greater biodiversity.

Lentic Checklist

Name of Riparian-Wetland Area:			
Date:		**Segment/Reach ID:**	
ID Team Observers:			
Potential/Capability:			

Yes	No	N/A	HYDROLOGICAL
			1Riparian-wetland area is saturated at or near the surface or inundated in “relatively frequent” events. **Notes:**
			2) Fluctuation of water levels is not excessive. **Notes:**
			3) Riparian-wetland area is enlarging or has achieved potential extent. **Notes:**
			4) Upland watershed is not contributing to riparian-wetland degradation. **Notes:**
			5) Water quality is sufficient to support riparian-wetland degradation. **Notes:**
			6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities). **Notes:**
			7) Structure accommodates sage passage of flows (e.g., no headcut affecting dam or spillway). **Notes:**
Yes	**No**	**N/A**	**VEGETATION**
			8) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery). **Notes:**
			9) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery). *[species present]* **Notes:**
			10) Species present indicate maintenance of riparian-wetland soil moisture characteristics. **Notes:**
			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt). *[community types present]* **Notes:**
			12) Riparian-wetland plants exhibit high vigor. **Notes:**

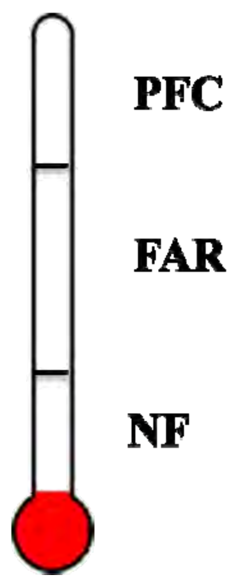
			13) Adequate riparian-wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows *[enough?]* **Notes:**
			14) Frost or abnormal hydrologic heaving is not present. **Notes:**
			15) Favorable microsite condition (i.e., woody material, water temperature, etc.,) is maintained by adjacent site characteristics. **Notes:**
Yes	**No**	**N/A**	**EROSION DEPOSITION**
			16) Accumulation of chenicals affecting plant productivity/composition is not apparent. **Notes:**
			17) Saturation of soils (i.e., ponding, flodding frequency, and duration) is sufficient to compose and maintain hydric soils. **Notes:**
			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation. **Notes:**
			19) Riparian-wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition). **Notes:**
			17) Island and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave events energies. **Notes:**

SUMMARY DETERMINATION

Functional Rating:
____ Proper Functioning Condition
____ Functional – At Risk
____ Nonfunctional
____ Unknown

Trend for Functional – At Risk:
____ Upward
____ Downward
____ Not Apparent

Are factors contributing to unacceptable conditions outside the control of the manager?
Yes ____ No ____



If yes, what are those factors?
____ Flow regulations
____ Mining activities
____ Upstream channel conditions
____ Channelization
____ Road encroachment
____ Oil Field water discharge
____ Augmented flows
____ Other (specify) ________________________

Are factors contributing to unacceptable conditions within the control of the manager?
Yes ____ No ____
If yes, what are those factors? ______________
____
____

Lentic riparian-wetland areas are functioning properly when adequate vegetation, landform, or debris is present to: Dissipate stream energy associated with wind and wave action, and overland flow from adjacent sites, thereby reducing erosion and improving water quality; Filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and ground-water recharge; Develop root masses that stabilize islands and shoreline features against cutting action; restrict water percolation; Develop diverse ponding characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and Support greater biodiversity.

Appendix 4A – Cold Creek Lotic Checklist

coldcreek [illegible]@yahoo.com

Lotic Checklist

Name of Riparian-Wetland Area:	Cold Creek up from Rd onto HT		
Date:	3/19/14	Segment/Reach ID:	
ID Team Observers:	Bob Hall Robin Wignall Jim Hilja		

Potential/Capability: Aroyo willow Spring stream w/ a watershed Maybe anastamosed sedge rush w/gravel catching thunder w/ 50-100 yrd fan/floodplain splays storm w/more water

Yes	No	N/A	HYDROLOGICAL
✓	✓		1) Floodplain above bankfull is inundated in "relatively frequent" events. **Notes:** New floodplain is Not terrace or inset fan/floodplain valley flat
		✓	2) Where beaver dams are present they are active and stable. **Notes:**
	✓	■	3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region). **Notes:** wide & less sinuous & steep
	✓		4) Riparian-wetland area is widening or has achieved potential extent. **Notes:** bluegrass lack of willows where it could grow
	✓	■	5) Upland watershed is not contributing to riparian-wetland degradation. **Notes:** private roads, w/ treatment not the essence of the problem also horse hosing & poor road maintenance → [illegible] steep [illegible]

Yes	No	N/A	VEGETATION
	✓		6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery). **Notes:** Almost none or none a ranunculus no salix
✓			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery). **Notes:** *[species present =]* aroyo willow a carex + a rush herb yes woody yes
	✓		8) Species present indicate maintenance of riparian-wetland soil moisture characteristics. **Notes:** very minimal presence may be wet but plant don't say so
	✓		9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high streamflow events. *[community types present]* **Notes:** bluegrass
	✓		10) Riparian-wetland plants exhibit high vigor. **Notes:** stressed from consistent
	✓		11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows *[enough?]* **Notes:** ≈ 5-10%
	✓		12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery). **Notes:** Missing willow root crows

Yes	No	N/A	EROSION DEPOSITION
	✓		13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) adequate to dissipate energy. **Notes:** Unvegetated & narrow in places
	✓		14) Point bars are revegetating with riparian-wetland vegetation. **Notes:** bluegrass or none
[illegible]	✓		15) Lateral stream movement is associated with natural sinuosity. **Notes:** ✓ Building point bars on step treads & accelerated erosion from incision regaining self[illegible]
	✓		16) System is vertically stable. *[not downcutting]* **Notes:** headcutting in many places
	✓		17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition). **Notes:** too much energy in peakflows ✓ & incision ✓ w/ some deposits

SUMMARY DETERMINATION

Functional Rating
___ Proper Functioning Condition
___ Functional - At Risk
_✓_ Nonfunctional
___ Unknown

Trend for Functional - At Risk:
___ Upward
_✓_ Downward
___ Not Apparent

Are factors contributing to unacceptable conditions outside the control of the manager?
Yes _✓_ No ___

If yes, what are those factors?
___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
_✓_ Other (specify) Urbanization of [illegible] & politically uncontrollable horse [illegible]

Are factors contributing to unacceptable conditions within the control of the manager?
Yes _✓_ No ___
If yes, what are those factors? Horse mgmt. could include riparian pasture

(Revised 1998) (7/2012)

Lotic riparian-wetland areas are considered to be in proper functioning condition when adequate vegetation, landform, or large woody debris is present to:

- dissipate stream energy associated with high waterflow, thereby reducing erosion and improving water quality;
- filter sediment, capture bedload, and aid floodplain development;
- improve flood-water retention and ground-water recharge;
- develop root masses that stabilize streambanks against cutting action;
- develop diverse ponding and channel characteristics *to provide* the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses;
- support greater biodiversity.

Appendix 4B – Cold Creek Fire Station Lentic Checklist

Lentic Checklist

Name of Riparian-Wetland Area:	Cold Creek Rude Ranch by Fire Bldg		
Date: 3/19/14	Segment/Reach ID:	Enclosure & Top Pond by Cold Spring	
ID Team Observers:	Robin Wignall Bob Hall Sherm S. Fire house		

Potential/Capability: Artificially irrigated meadow & pond for fire fighting

Yes	No	N/A	HYDROLOGICAL
✓			1) Riparian-wetland area is saturated at or near the surface or inundated in "relatively frequent" events. Notes: but not to margins of organic rich soil.
✓			2) Fluctuation of water levels is not excessive. Notes:
	✓		3) Riparian-wetland area is enlarging or has achieved potential extent. Notes: digging a channel! spreading water, which is preventing reaching potential
✓			4) Upland watershed is not contributing to riparian-wetland degradation. Notes: diversion augmenting
✓			5) Water quality is sufficient to support riparian-wetland plants. Notes:
	✓		6) Natural surface or subsurface flow patterns are not altered by disturbance (i.e., hoof action, dams, dikes, trails, roads, rills, gullies, drilling activities). Notes: dug channel/trenching
	✓		7) Structure accommodates safe passage of flows (e.g., no headcut affecting dam or spillway). Notes: neither stabilized or function spillway & horses will likely send water over dam

Yes	No	N/A	VEGETATION
	✓		8) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery). Notes: little or no examples; lack of young willow/cottonwood
✓			9) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery). *[species present]* Notes: Carex & [illegible] sedge (Nebraska) Juncus
✓			10) Species present indicate maintenance of riparian-wetland soil moisture characteristics. Notes: Arroyo Willow, Fremont cottonwood, Black willow, sedge, rush, [illegible]
✓			11) Vegetation is comprised of those plants or plant communities that have root masses capable of withstanding wind events, wave flow events, or overland flows (e.g., storm events, snowmelt). *[community types present]* Notes: willow
	✓		12) Riparian-wetland plants exhibit high vigor. Notes: Fence new & past grazing still a stressor

Yes	No	N/A	
	✓		13) Adequate riparian-wetland vegetative cover is present to protect shoreline/soil surface and dissipate energy during high wind and wave events or overland flows. [enough?] Notes: Pond areas is not well vegetated
✓			14) Frost or abnormal hydrologic heaving is not present. Notes:
		✓	15) Favorable microsite condition (i.e., woody material, water temperature, etc.) is maintained by adjacent site characteristics. Notes:

Yes	No	N/A	EROSION DEPOSITION
✓			16) Accumulation of chemicals affecting plant productivity/composition is not apparent. Notes:
✓			17) Saturation of soils (i.e., ponding, flooding frequency, and duration) is sufficient to compose and maintain hydric soils. Notes: along ponds maybe just on edge of water not 3.5 ft away
✓			18) Underlying geologic structure/soil material/permafrost is capable of restricting water percolation. Notes:
	✓		19) Riparian-wetland is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition). Notes: Parking lot use putting sediment into pond rarely 1ft of veg
		✓	20) Islands and shoreline characteristics (i.e., rocks, coarse and/or large woody material) are adequate to dissipate wind and wave event energies. Notes:

SUMMARY DETERMINATION

Functional Rating

___ Proper Functioning Condition
_✓_ Functional - At Risk
___ Nonfunctional
___ Unknown

Trend for Functional - At Risk:

___ Upward
_✓_ Downward
___ Not Apparent

Are factors contributing to unacceptable conditions outside the control of the manager?
Yes ___ No _✓_

(Revised 1998) (7/2012)

PFC

FAR

NF

If yes, what are those factors?
___ Flow regulations
___ Mining activities
___ Upstream channel conditions
___ Channelization
___ Road encroachment
___ Oil field water discharge
___ Augmented flows
___ Other (specify) ___

Are factors contributing to unacceptable conditions outside the control of the manager?
Yes _✓_ No ___
If yes, what are those factors? Stone Rcy hobbies new acquired & managed pond not managed

Lentic riparian-wetland areas are functioning properly when adequate vegetation, landform, or debris is present to:

- dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, thereby reducing erosion and improving water quality;
- filter sediment and aid floodplain development; improve flood-water retention and ground-water recharge;
- develop root masses that stabilize islands and shoreline features against cutting action; restrict water percolation;
- develop diverse ponding characteristics to provide the habitat and water depth, duration, and temperature necessary for fish production, waterbird breeding, and other uses; and
- support greater biodiversity.

Appendix 5 – Workshop Evaluation Forms

EVALUATION
Riparian Proper Functioning Condition Workshop
Las Vegas **Gerlach, Nevada**
~~**October 10 - 11, 2012**~~ 3/18-20/14

In order to help evaluate the strengths and weaknesses of this workshop, please indicate below the extent to which the Riparian Proper Functioning Condition Workshop has accomplished the following:

Workshop Quality	**(1 = strongly disagree**		**to**		**5 = strongly agree)**
Was workshop content appropriate?	1	2	3	(4)	5
Were presentations understandable?	1	2	(3)	4	5
Workshop Usefulness					
Was this workshop worth your time?	1	2	3	4	(5)
Do you plan to use any information that you learned?	1	2	3	4	(5)

Miscellaneous

How will you apply the principles of the riparian PFC assessment process on your ranch or allotment(s)?

We will be using PFC to assess spring sites throughout our district

Have you been to previous riparian PFC workshops in Nevada? Yes (No)

If you have attended such workshops before, are you using any information that you learned? Yes No

What did you like best about this workshop?

Practical use in the field

What changes would you suggest?

More time for practical use, if not enough time, manage it better to help us learn, not just setting us loose to waste time kicking rocks. better power-point presentations; they are intended as an infographic to aid in the understanding ~~What would help you as a follow-up?~~ of the processes, not a wordy essay!

Practical use produces useful questions. don't waste good training time with management suggestions, it's not entirely why we are here.

What about springs?? PFC on springs is useful for Southern Nevada region.

THANKS FOR YOUR PARTICIPATION!

Thank you!

EVALUATION

Riparian Proper Functioning Condition Workshop

Las Vegas ~~Gerlach~~, Nevada

~~October 10 - 11, 2012~~ 3/18-20/14

In order to help evaluate the strengths and weaknesses of this workshop, please indicate below the extent to which the Riparian Proper Functioning Condition Workshop has accomplished the following:

Workshop Quality	**(1 = strongly disagree**	**to**			**5 = strongly agree)**
Was workshop content appropriate?	1	2	3	(4)	5
Were presentations understandable?	(1)	2	3	4	5
Workshop Usefulness					
Was this workshop worth your time?	1	2	3	4	(5)
Do you plan to use any information that you learned?	1	2	3	4	(5)

Miscellaneous

How will you apply the principles of the riparian PFC assessment process on your ranch or allotment(s)?

Performing PFC assessments on Allotments

Have you been to previous riparian PFC workshops in Nevada? (Yes) No

If you have attended such workshops before, are you using any information that you learned? (Yes) No

What did you like best about this workshop?

Looking at several examples

What changes would you suggest?

Longer training and more focus on worksheet

What would help you as a follow-up?

THANKS FOR YOUR PARTICIPATION!

EVALUATION

Riparian Proper Functioning Condition Workshop

Las Vegas ~~**Gerlach**~~**, Nevada**

~~**October 10 – 11, 2012**~~ 3/18-20/14

In order to help evaluate the strengths and weaknesses of this workshop, please indicate below the extent to which the Riparian Proper Functioning Condition Workshop has accomplished the following:

Workshop Quality	**(1 = strongly disagree**	**to**			**5 = strongly agree)**
Was workshop content appropriate?	1	2	3	4	(5)
Were presentations understandable?	1	2	3	4	(5)
Workshop Usefulness					
Was this workshop worth your time?	1	2	3	4	(5)
Do you plan to use any information that you learned?	1	2	3	4	(5)

Miscellaneous

How will you apply the principles of the riparian PFC assessment process on your ranch or allotment(s)?

Have you been to previous riparian PFC workshops in Nevada? Yes (No)

If you have attended such workshops before, are you using any information that you learned? Yes No

What did you like best about this workshop?
Asking questions for clarification when we were in the field.

What changes would you suggest?
More time in the field.

What would help you as a follow-up?
To have a copy of the slides.

THANKS FOR YOUR PARTICIPATION!

EVALUATION
Riparian Proper Functioning Condition Workshop
Las Vegas ~~Gerlach, Nevada~~
~~October 10 - 11, 2012~~ 3/18-20/14

In order to help evaluate the strengths and weaknesses of this workshop, please indicate below the extent to which the Riparian Proper Functioning Condition Workshop has accomplished the following:

Workshop Quality	(1 = strongly disagree to 5 = strongly agree)				
Was workshop content appropriate?	1	2	3	4	(5)
Were presentations understandable?	1	2	3	4	(5)
Workshop Usefulness					
Was this workshop worth your time?	1	2	3	4	(5)
Do you plan to use any information that you learned?	1	2	3	4	(5)

Miscellaneous

How will you apply the principles of the riparian PFC assessment process on your ranch or allotment(s)? Use the principles to review and improve our Non Point Source Mgmt. plan.

Have you been to previous riparian PFC workshops in Nevada? Yes (No)

If you have attended such workshops before, are you using any information that you learned? (Yes) No
Non point source Academy.

What did you like best about this workshop?
Networking and resources.

What changes would you suggest? Maybe pre materials

What would help you as a follow-up?
Tech Assistance in review/comments of revised Non point source mgmt plan.
It was a great workshop. The facilitators

THANKS FOR YOUR PARTICIPATION!

EVALUATION

Riparian Proper Functioning Condition Workshop

Las Vegas ~~Gerlach,~~ **Nevada**

~~October 10 - 11, 2012~~ 3/18-20/14

In order to help evaluate the strengths and weaknesses of this workshop, please indicate below the extent to which the Riparian Proper Functioning Condition Workshop has accomplished the following:

Workshop Quality	**(1 = strongly disagree to**				**5 = strongly agree)**
Was workshop content appropriate?	1	2	3	(4)	5
Were presentations understandable?	1	2	3	4	(5)
Workshop Usefulness					
Was this workshop worth your time?	1	2	3	4	(5)
Do you plan to use any information that you learned?	1	2	3	4	(5)

Miscellaneous

How will you apply the principles of the riparian PFC assessment process on your ranch or allotment(s)? I like the holistic approach. I like the principles that I will promote the principles as an outreach. Principle aligns with what is promote by Quivira Coalition. Added more

Have you been to previous riparian PFC workshops in Nevada? Yes (No)

If you have attended such workshops before, are you using any information that you learned? (Yes) No

Similar to what was provided by Quivira Calition

What did you like best about this workshop?

Overall. Needed more time for all. lectures & field work.

What changes would you suggest?

extend workshop, post the Power Point slides online produce condense version of all PPT presentations.

What would help you as a follow-up?

Samples of previous projects & reports. Host A Conference for Tribal EPA on PFC.

THANKS FOR YOUR PARTICIPATION!

EVALUATION

Riparian Proper Functioning Condition Workshop

Los Vegas ~~Gerlach,~~ **Nevada**

~~**October 10 – 11, 2012**~~ 3/18 – 20/14

In order to help evaluate the strengths and weaknesses of this workshop, please indicate below the extent to which the Riparian Proper Functioning Condition Workshop has accomplished the following:

Workshop Quality	**(1 = strongly disagree**		**to**		**5 = strongly agree)**
Was workshop content appropriate?	1	2	3	4	(5)
Were presentations understandable?	1	2	3	4	(5)
Workshop Usefulness					
Was this workshop worth your time?	1	2	3	4	(5)
Do you plan to use any information that you learned?	1	2	3	4	(5)

Miscellaneous

How will you apply the principles of the riparian PFC assessment process on your ranch or allotment(s)?

Net water quality
Vegetation

Have you been to previous riparian PFC workshops in Nevada? Yes (No)

If you have attended such workshops before, are you using any information that you learned? Yes No

What did you like best about this workshop?

~~Garden~~ Hands on going into the field

What changes would you suggest?

N/A

What would help you as a follow-up?

N/A

THANKS FOR YOUR PARTICIPATION!

EVALUATION
Riparian Proper Functioning Condition Workshop
Las Vegas ~~Gerlach,~~ **Nevada**
October 10 - 11, 2012 3/18-20/14

In order to help evaluate the strengths and weaknesses of this workshop, please indicate below the extent to which the Riparian Proper Functioning Condition Workshop has accomplished the following:

Workshop Quality	**(1 = strongly disagree**		**to**		**5 = strongly agree)**
Was workshop content appropriate?	1	(2)	3	4	5
Were presentations understandable?	(1)	2	3	4	5
Workshop Usefulness					
Was this workshop worth your time?	(1)	2	3	4	5
Do you plan to use any information that you learned?	(1)	2	3	4	5

Miscellaneous

How will you apply the principles of the riparian PFC assessment process on your ranch or allotment(s)?
I will add these types of assessments to 106+319 program

Have you been to previous riparian PFC workshops in Nevada? Yes (No)

If you have attended such workshops before, are you using any information that you learned? Yes No N/A

What did you like best about this workshop?
getting out into the field and working through the sheets seeing the process in action

What changes would you suggest?
It would be good to also see a properly functioning system to see the difference
I would use more non-grazing examples because it would give us more variety of how to deal w/ different sessions

What would help you as a follow-up?
doing more of these worksheets in different areas.

THANKS FOR YOUR PARTICIPATION!

EVALUATION

Riparian Proper Functioning Condition Workshop

Las Vegas ~~Gerlach,~~ **Nevada**

~~October 10 - 11, 2012~~ 3/18 – 20/14

In order to help evaluate the strengths and weaknesses of this workshop, please indicate below the extent to which the Riparian Proper Functioning Condition Workshop has accomplished the following:

Workshop Quality	**(1 = strongly disagree**		**to**		**5 = strongly agree)**
Was workshop content appropriate?	(1)	2	3	4	5
Were presentations understandable?	1	2	(3)	4	5
Workshop Usefulness					
Was this workshop worth your time?	(1)	2	3	4	5
Do you plan to use any information that you learned?	1	(2)	3	4	5

Miscellaneous

How will you apply the principles of the riparian PFC assessment process on your ranch or allotment(s)? DO NOT HAVE RANCH OR ALLOTMENTS.

Have you been to previous riparian PFC workshops in Nevada? Yes (No)

If you have attended such workshops before, are you using any information that you learned? Yes No

What did you like best about this workshop? FIELD WORK, EXPLANATION OF CHECK LISTS

What changes would you suggest? PRESENTATION HANDOUTS (WITHOUT PHOTOGRAPHS TO SAVE INK) GIVEN TO STUDENTS PRIOR TO LECTURES. CLEARER PRESENTATION OUTLINE.

What would help you as a follow-up?

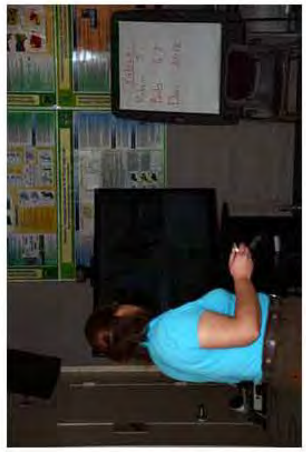
RECEIVE DIGITAL COPYS OF PRESENTATIONS

WELL DONE! :)

THANKS FOR YOUR PARTICIPATION!

Appendix 6 – Tribal Ecosystem Research Program (TERP) Workshop Contact Sheets March 18 – 20, 2014 • Las Vegas, Nevada


Class 1 - Robin.jpg


Class 2 - Robin.jpg

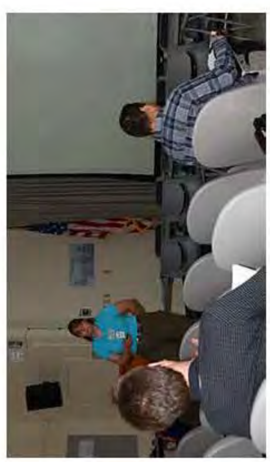

Class 3 - Robin.jpg

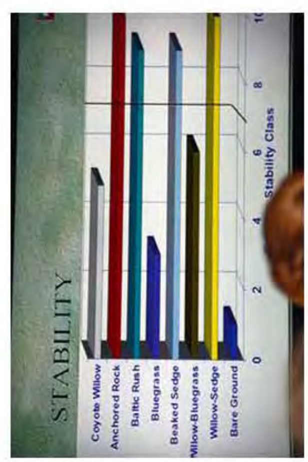

Class 4 - Group.jpg


Class 5 - Robin.jpg


Class 6 - Group 2.jpg


Class 7 - Robin.jpg


Class 8 - Robin.jpg

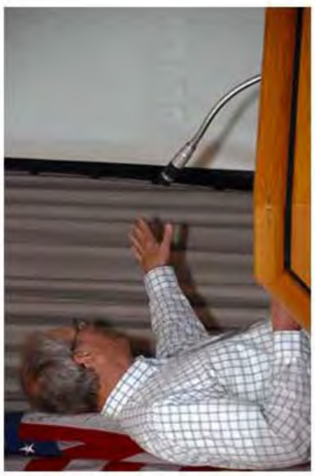


Class 9 - Slide.jpg

Class 10 - Sherm.jpg

Class 11 - Group 3.jpg

Class 12 - Bob.jpg



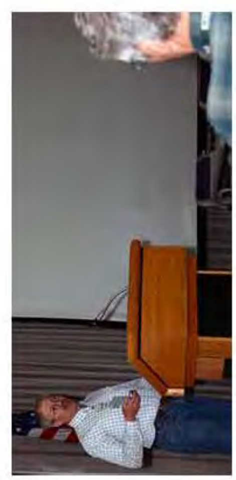
Class 13 - Sherm.jpg

Class 14 - Sherm.jpg

Class 15 - Group 4.jpg

Class 16 - Sherm.jpg

Class 17 - Sherm.jpg



Class 18 - Sherm.jpg


Class 19 - Bob-Youngping.jpg


Class 20 - Sherm.jpg


Class 21 - Sherm.jpg


Class 22 - Sherm Group.jpg


Class 23 - Sherm Group 2.jpg


Class 24 - Group 5.jpg


Class 25 - Sherm .jpg


Class 26 - Sherm.jpg


Class 27 - Group 6.jpg


Class 28 - Bob Dan - Group.jpg


class 29 - Group 7.jpg


Class 30 - Group 8.jpg


Class 31 - Group 9.jpg


Class 32 - Sherm - Woman.jpg


Class 33 - Dan Group.jpg


Class 34 - Bob - Tribal.jpg


Class 35 - Bob-Tribal 2.jpg


Class 36 - Bob - Tribal 3.jpg


Class 37 - Dan - Tribal 1.jpg


Class 38 - Dan - Tribal 2.jpg


Class 39 - Dan - Tribal 3.jpg


Class 40 - Dan - Tibal 4.jpg


Class 41 - Sherm Point.jpg


Class 42 - Sherm Point 2.jpg


Class 43 - Sherm rising jesture.jpg


Class 44 - Sherm Width.jpg


Class 45 - Sherm.jpg


Class 46 - Sherm Group 3.jpg


Class 47 - Sherm Group 4.jpg


Class 48 - Sherm Group 5.jpg

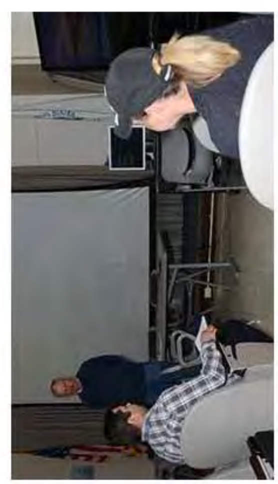

Class 49 - Sherm Lecture.jpg


Class 50 - Sherm Lecture 2.jpg


Class 51 - Audience 1.jpg

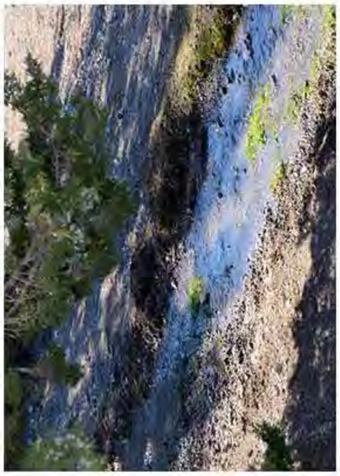

Class 52 - Sherm Lecture 3.jpg


Class 53 - Sherm Lecture 4.jpg


Class 54 - Sherm - Group 6.jpg


Class 55 - Sherm Lecture 5.jpg


Class 56 - Sherm Lecture 6.jpg


2nd Site - Stream 3.jpg

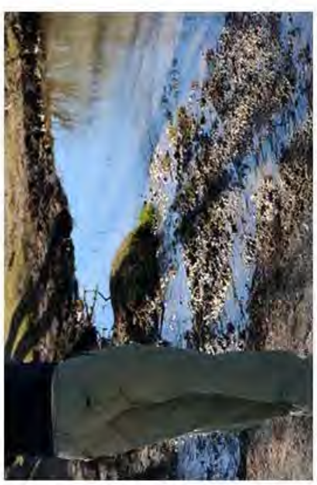

2nd site stream - tree.jpg


Brush Small Stream 2.jpg


Brush Small Stream.jpg


Close-Stream-Flow.jpg


dead bush_stream.jpg


Diversion - 2nd Site - 2.jpg


Diversion - 2nd Site.jpg


dry bed 1.jpg


dry bed 2.jpg


eroded stream bed.jpg


Fallen Tree.jpg


Fenced Tree Stream.jpg


Fish - 1.jpg


Fish - 2.jpg


Fish - 3.jpg


Fish - 4.jpg


hillside stream.jpg


Leaves In Stream.jpg


rocks stream.jpg


Shrub Stream Hill.jpg


Small Stream 1.jpg


Small Stream 2.jpg


small stream 3.jpg


Small Stream 4.jpg


small winding creek.jpg


small winding stream.jpg


Stream Bend.jpg


stream - brush.jpg


Stream - Dead Bush.jpg


stream 1.jpg


stream 2 - dense brush.jpg


stream 2 recession.jpg


Stream 2.jpg


stream bank recession 2.jpg


Stream bank recession 3.jpg


stream bank recession.jpg


stream bed change.jpg


stream bend.jpg


stream boulder 2.jpg


stream boulder 3.jpg


stream boulder.jpg


stream brush 2.jpg


stream brush bushes.jpg


stream brush.jpg

Stream Cascade.jpg

stream debris.jpg

stream dry branch.jpg

stream erosion_grass.jpg

stream erosion.jpg

stream flow 1.jpg

Stream Flow Close 2.jpg

Stream Flow Close.jpg

stream grasses.jpg

stream hill.jpg

stream hillside.jpg

stream part 2.jpg

stream part two - 2.jpg

Stream Snow - 2.jpg

stream snow.jpg

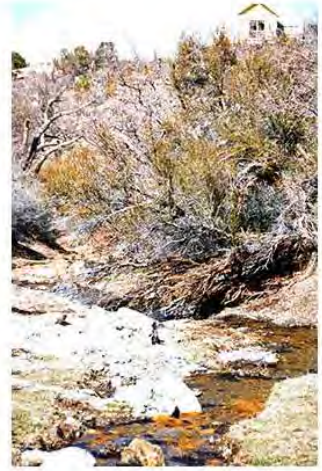
stream twin fork.jpg

stream_brush.jpg

Stream-Flow-Boot.jpg

Tree - bed.jpg

undergrowth stream.jpg



winding stream_house.jpg

winding stream.jpg

Winding-Stream-2.jpg

Winding-Stream-Small.jpg

Winding-Stream.jpg

Break Group 2.jpg

Break Group.jpg

Dan 2.jpg

Dan 3.jpg

Dan Group - 2nd Site - 2.jpg

Dan Group - 2nd Site - 3.jpg

Dan Group - Second Site.jpg

Dan Group 2nd Site.jpg

Dan Hand - Grass & Cress.jpg


Dan Hand - Sturdy Grass.jpg


Dan Hand - Water Cress.jpg


Dan Talk.jpg


Dan-1.jpg


Flappy Hat Group.jpg


Floppy hat 1.jpg


floppy hat 2.jpg


Floppy Hat Group.jpg


Group 1.jpg

group 2nd site.jpg

Group at 2nd Site.jpg

Linda 2nd Site.jpg

question answer 1.jpg

question answer 2.jpg

question answer 3.jpg

Robin - sample 2nd site.jpg

Robin - Sample Site 2 - Fish.jpg

Robin - Sample Site 2 Fish 2.jpg

Robin 1.jpg

Robin Dan Group 2.jpg

Robin Dan Group 3.jpg

Robin Dan Group 4.jpg

Robin Dan Group.jpg

Robin Group - Second Site - 2.jpg

Robin Group - Second Site - 3.jpg

Robin Group - Second Site w-Pam.jpg

Robin Group - Second Site.jpg


Robin Sample 1.jpg


Robin Sample 2.jpg


Robin Sample 2nd Site - 2.jpg


Robin Sample 2nd Site - 3.jpg


Robin Sample 3.jpg


Robin sample 4.jpg


robin sample 5.jpg


Robin Sample 6.jpg


Robin Sample 7.jpg

Robin sample 8.jpg

Robin Talk.jpg

Robin Talking 2.jpg

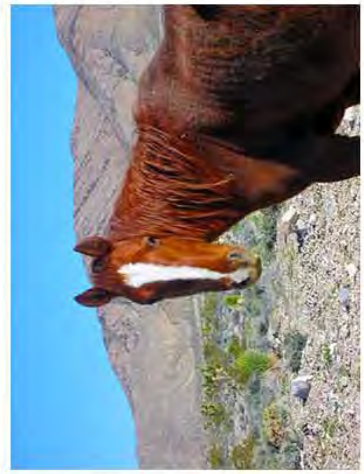
Robin-1.jpg

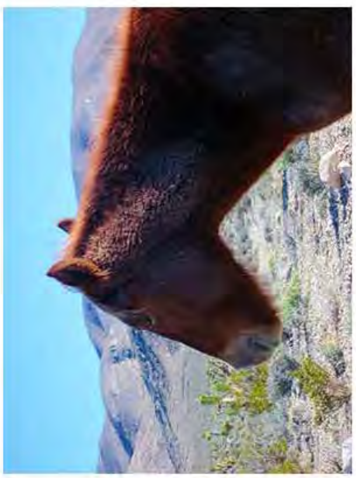
woman 2nd site - 2.jpg

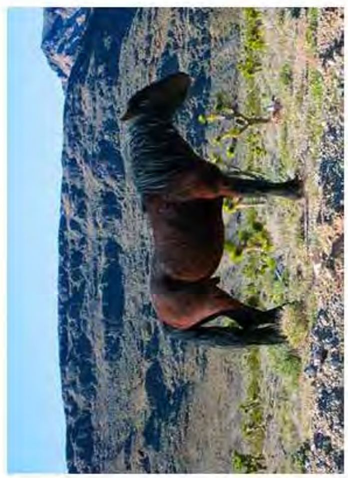
woman 2nd site.jpg


Wild Horse 2.jpg


Wild Horse 3.jpg

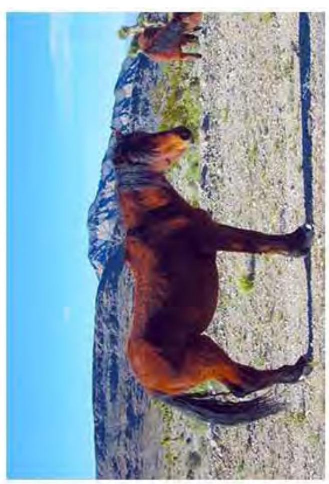

Wild Horse 5.jpg


Wild Horse Head.jpg

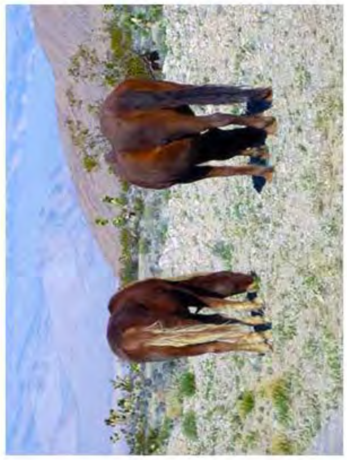

Wild Horse Side 2.jpg


Wild Horse Side.jpg


Wild Horse Side(small).jpg


Wild Horses 1.jpg

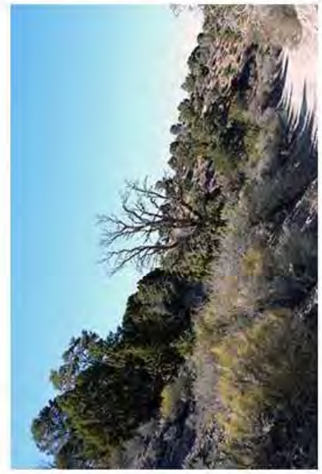

Wild Horses 4.jpg



Wild Hoses Grazing.jpg

brush stump.jpg

Cold Creek Hill Side 5.jpg



Cold Creek Hill Side.jpg

Cold Creek Hillside 2.jpg

Cold Creek Hillside 3.jpg

Cold Creek Hillside 4.jpg

Cold Creek Hillside 5.jpg

Cold Creek Hillside.jpg

United States
Environmental Protection
Agency

Office of Research
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