Linking Changes in Management and Riparian Physical Functionality to Water Quality and Aquatic Habitat

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Abstract

Rangeland water quality depends on riparian and watershed management for the functions of riparian ecosystems. Functions integrate soil and landform, water, and vegetation conditions and processes effecting erosion and deposition and assimilation or uptake and release nutrients and pollutants. Anthropogenically altered riparian conditions often lead to hydrologic and riparian habitat alterations and the release of materials stored through millennia. Riparian proper functioning condition (PFC) assessment empowers changes in management for recovery of vegetation, channel form, and water quality in north-central Nevada (Figure 1).

Introduction

PFC assessments interpret changes from management resulting in changes to water quality and aquatic habitat in Maggie Creek, a major tributary to the Humboldt River in north-central Nevada (Figure 2). With a history of agriculture, grazing and mining, impaired riparian function focused management changes for recovery. Controlled livestock grazing replaced season-long grazing in much of the watershed starting in 1994 (Figure 3). Areas where grazing management has not changed remain nonfunctional (Figure 4).

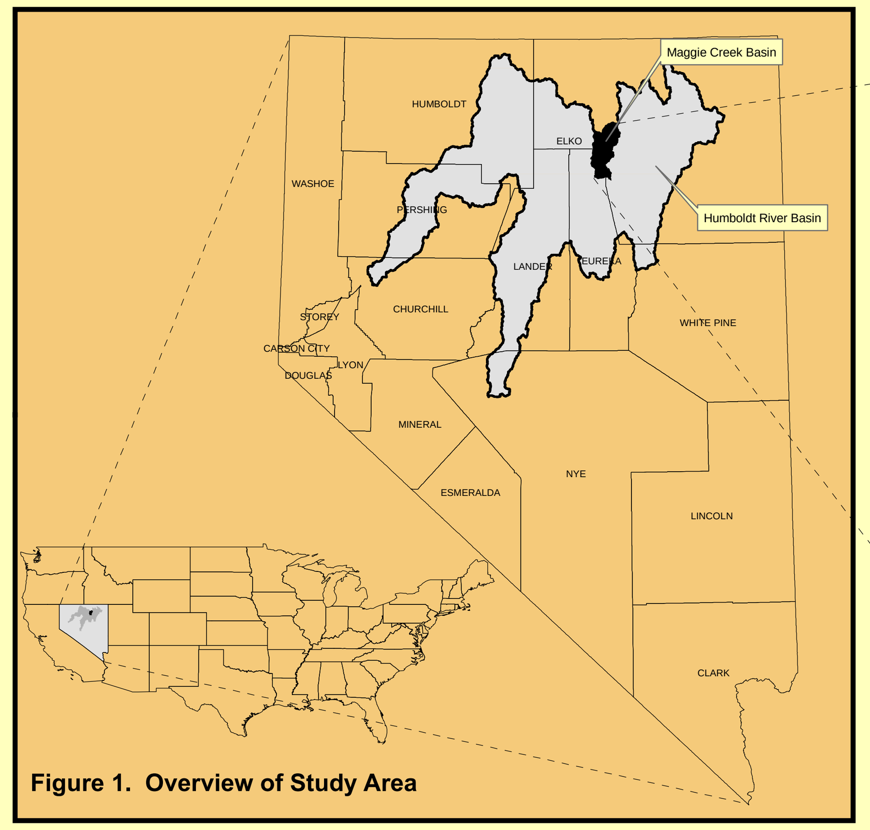


Figure 1. Overview of Study Area

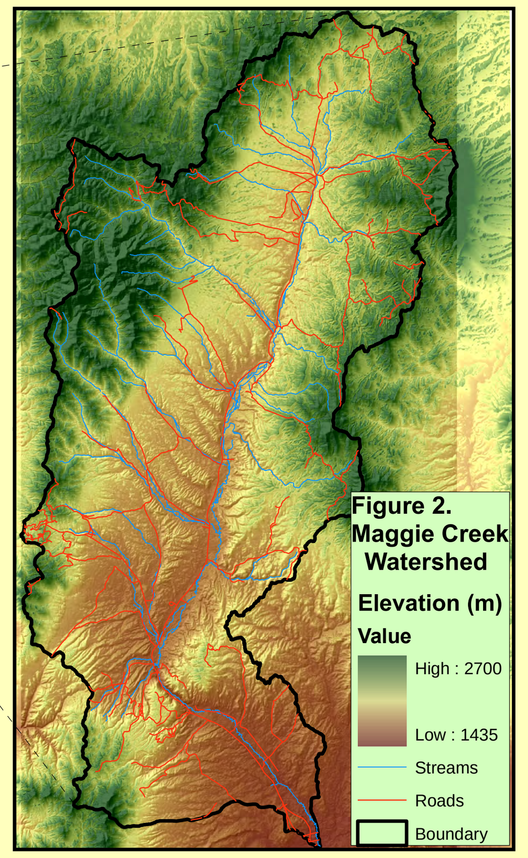


Figure 2. Maggie Creek Watershed

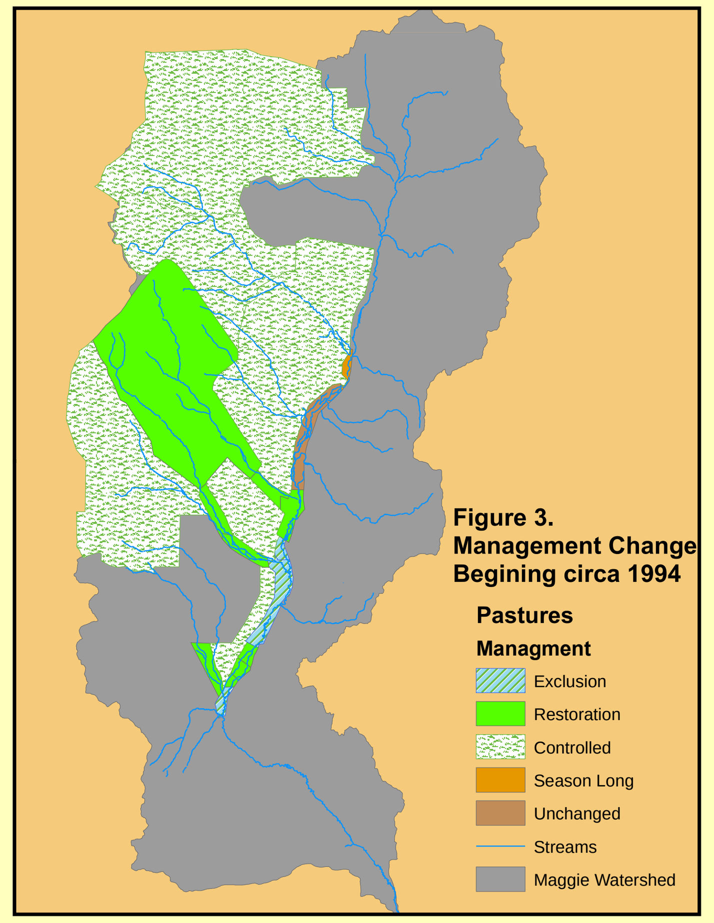
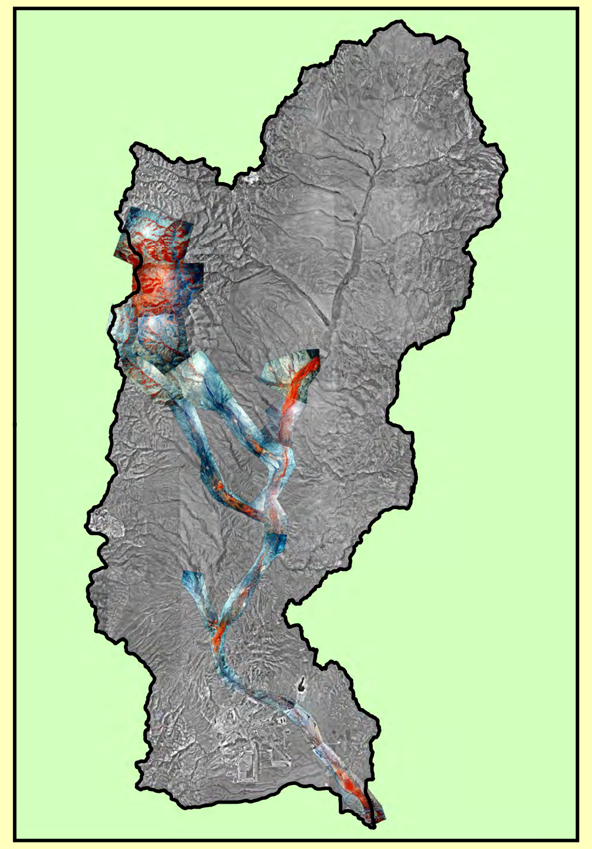
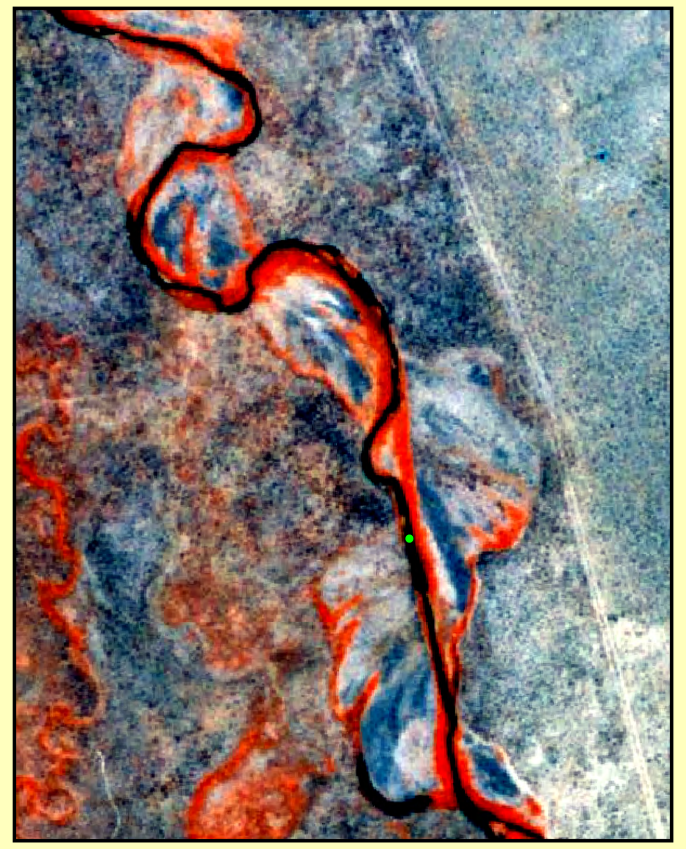
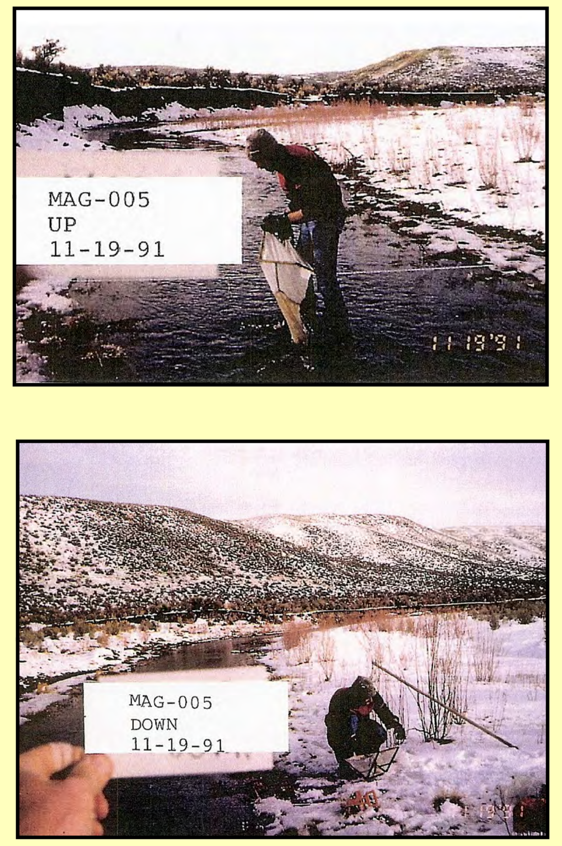


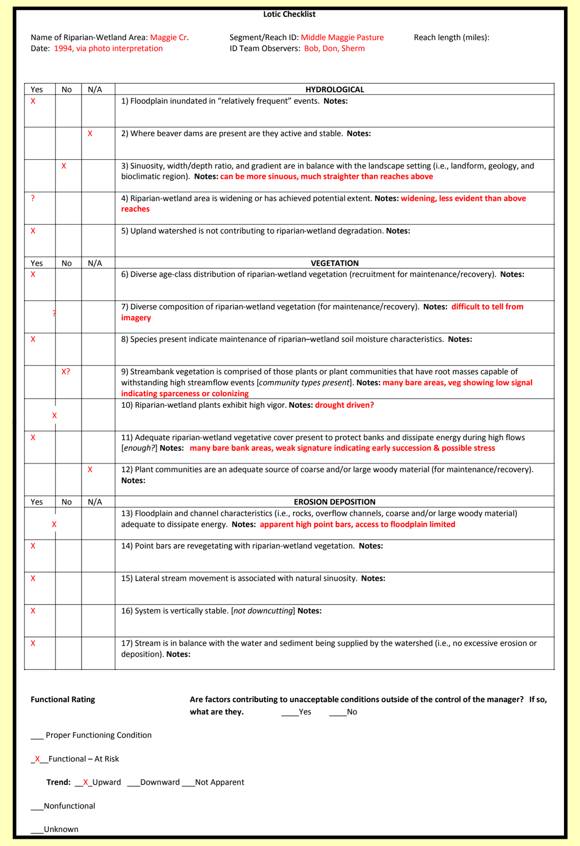
Figure 3. Management Change Begining circa 1994

Figure 4. A typical result of poor grazing management, examples of reaches in a physically nonfunctional condition. Photos taken in 2010.









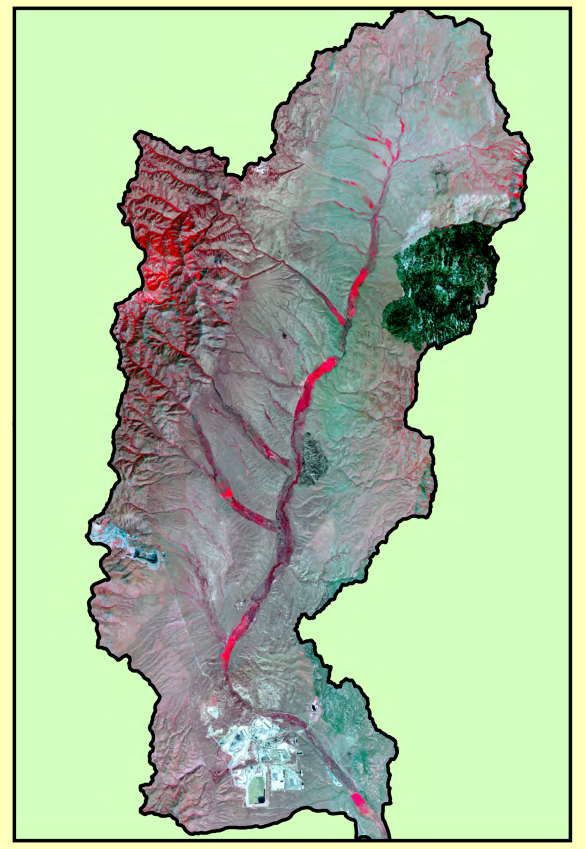
Group 1 Figures, 1994: a) Digital Ortho Quads overlain with Color Infrared (CIR) imagery, used to assess upland effects; b) CIR close-up of example reach, used to assess reach condition; c) ground photos at the station marked with a green dot in b (photos courtesy of BLM Elko District), used to help with validation; PFC assessment for this reach.

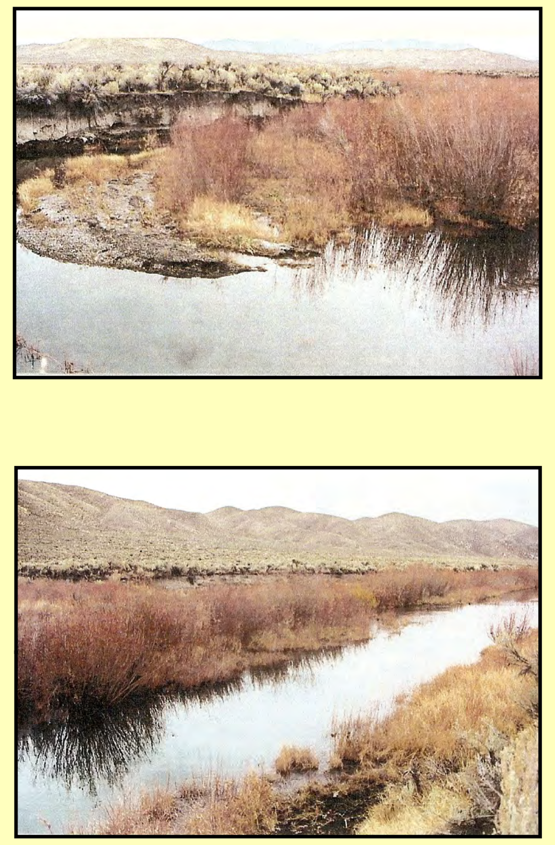
Methods

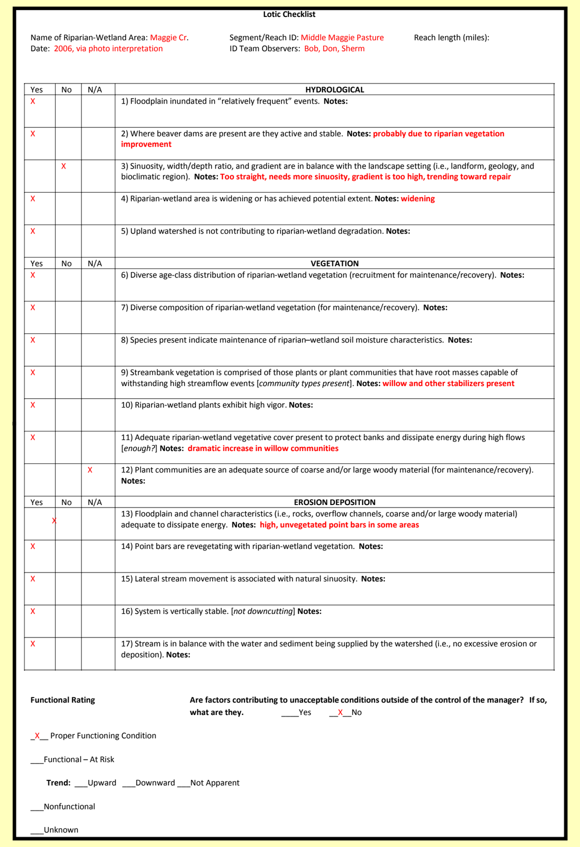
Trends in functionality from 1994 (Group 1 figures) to 2006 (Group 2 figures) were evaluated via on-the-ground assessments augmented with historic aerial and ground-based photographic interpretations. Aspects of water quality and biological communities have been monitored over this same time.

A riparian-wetland area is considered to be in PFC when adequate vegetation, landform, or large woody debris is present to (from TR1737-15 (Prichard, 1998)):
- **•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 water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses;**
- **•Support greater biodiversity.**

Interpretation of PFC for water quality adds layers of understanding that empowers adaptive management for watershed functions and water quality remediation.



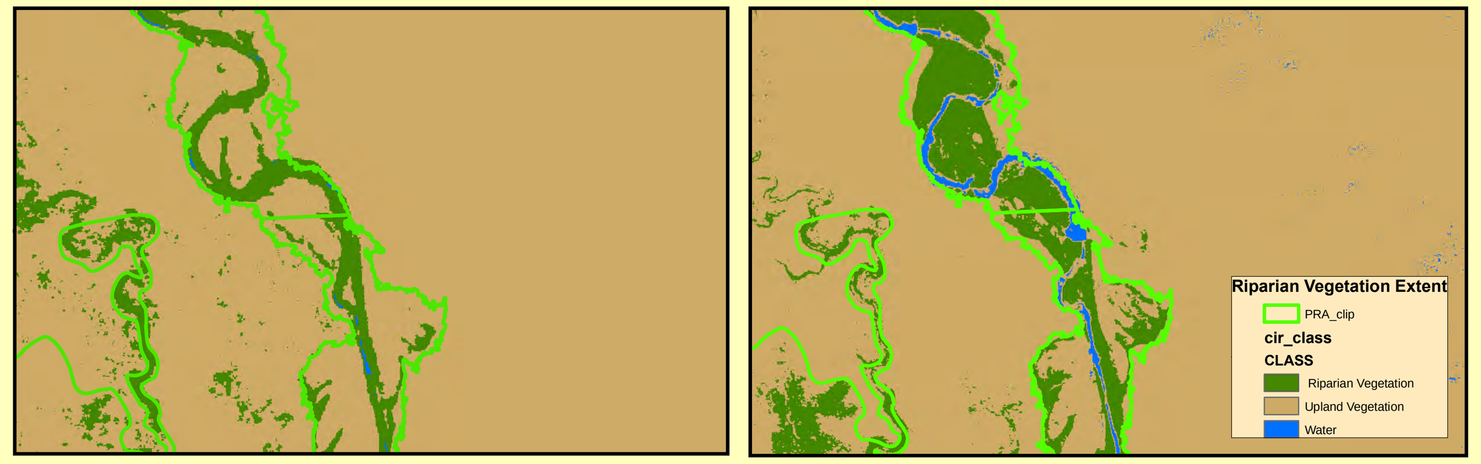




Group 2 Figures, 2006: a) National Agriculture Imagery Program Color Infrared (CIR) imagery; b) CIR close-up of example reach with Very Large Scale Aerial imagery inset; c) ground photos at the station marked with a green dot in b (photos courtesy of BLM Elko District); d) PFC assessment for this reach.

Results

Changes in grazing management have led to increases in riparian vegetation, especially stabilizing wetland species (Figure 5), which improved the physical functionality of the riparian system. More beaver forage and dams accelerated the systems return to better functionality (Figure 6) via greater floodplain access and deposition.



Figures 5. Riparian vegetation classification of NVDI derived from CIR imagery in Groups 1 and 2, image b, demonstrates a 26% increase in area from 1994 (left) to 2006 (right).

Figure 6. Increased riparian vegetation has created habitat for and enabled beaver to inhabit the riparian zone (left) helping to improve functionality and water quality within the system (right). Photos taken in 2010.

Conclusions

Ultimately improved functionality leads to improvement in water quality, dramatically reducing sediment in high flows (Figure 7). Many water quality problems stem from sediment. With increased functionality, we will test for other changes to water quality driven by assimilation and functionality.

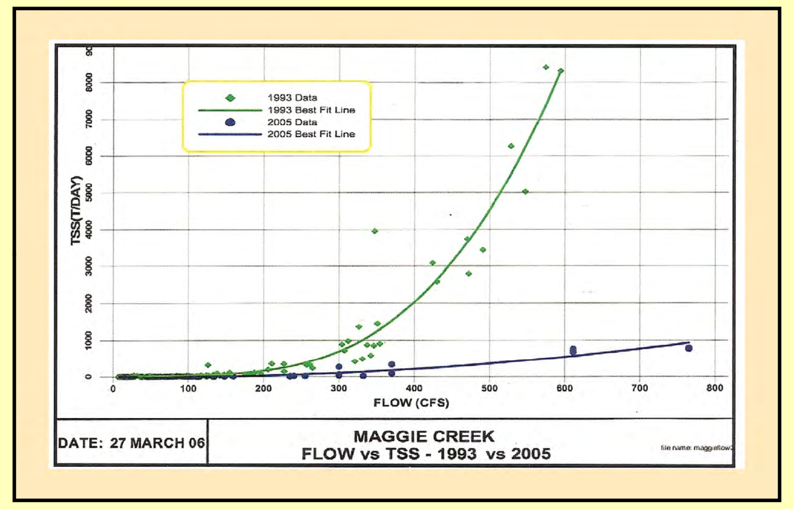


Figure 7. Over the span of this study, Total Suspended Solids (TSS) loads, an important pollutant in its own right but also a vehicle for other pollutants (e.g. nutrients, pathogens, pesticides) have decreased dramatically with increased flows. (Modified from Simonds, Ritchie, and Sant, 2009)

References

Prichard, D., J. Anderson, C. Correll, J. Fogg, K. Gebhardt, R. Krapf, S. Leonard, B. Mitchell, and J. Staats. 1998. Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and Supporting Science for Lotic Areas. USDI BLM, USDA FS and NRCS Technical Reference 1737-15, 126 pp.

Simonds, G., M. Ritchie, and E. Sant. 2009. Evaluating Riparian Condition and Trend in Three Large Watersheds. Open Range Consulting report to BLM Elko District.

Evans, C. 2009. Maggie Creek Watershed Restoration Project 1993 South Operations Area Project Mitigation Plan 2006 Monitoring Summary and Evaluation of Biological Standards. BLM Elko District report.

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