WALKER RANCH EXPERT REBUTTAL REPORT

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Background and Purpose

The purpose of this document is to rebut and/or question the assertions of Drs. Roy Roath, Edward Redente, and David Buckner as explicated in their Experts' Reports commissioned by Colorado Springs Utilities (CSU) in the case City of Colorado Springs v. Walker Ranches, LLLP (Case No. 2011-CV-313). Dr. Roy Roath of Rangelander Education and Consulting, LLC, in Fort Collins, CO, was hired by CSU to evaluate range conditions and watershed characteristics of the portion of the Southern Delivery System (SDS) pipeline that runs through Walker Ranch. Drs. Edward Redente and David Buckner were hired by CSU to evaluate pre-construction vegetation conditions on the portion of the SDS pipeline on Walker Ranch, revegetation practices implemented on the SDS pipeline right of way (ROW), first-year plant growth on the pipeline ROW, the findings of Walker Ranches relevant to the revegetation practices on the SDS pipeline, and the treatment recommendations proposed by Walker Ranches. In this report, the scientific names of plant species follow Weber and Wittmann (2012).

Approach and Methods

To prepare this report, we reviewed reports provided by Colorado Springs Utilities. We focused our review on the reports written by Dr. Roy Roath, Dr. Edward Redente, and Dr. David Buckner. We reviewed other pertinent reports. We visited Walker Ranches on September 22, 2013; May 5, 2014; and May 13-15, 2014. During the first two of these site visits, we concentrated our work along the SDS pipeline ROW and the lands adjacent to the ROW; during the last site visit, we expanded our work to include the Fountain Valley pipeline. During the May 13-15, 2014 site visit, we collected vegetation data from the Fountain Valley and the SDS pipeline ROWs (see Appendix 1).

MAJOR FINDINGS

1) The revegetation requirements stated in the 1041 permit from Pueblo County have not been met.

(a) Specification C-9 (Site Restoration) of the 1041 permit states that "Applicant shall provide Pueblo County residents with replacement vegetation and property to match pre-

existing conditions or better." Further, the Project Detail for C-9 states in item 2.b. that, "Vegetation cover will be of the same seasonal variety native to the area of disturbed land or species that support the post-construction land use." Based on visual inspection, review of aerial photographs, and field sampling, these mandates have not been met. Specifically, shrublands, which are integral to the character of this parcel of Walker Ranch, are not colonizing the site as hoped or predicted. Observations on the nearby Fountain Valley pipeline (disturbed three decades prior) show little colonization by four-wing saltbush and cholla (see Appendix 1), indicating that reestablishment of these shrubs from the soil seed bank and from nearby shrubs will occur very slowly on the SDS pipeline ROW.

(b) Reestablishment and survival of imperiled species growing on the ROW before pipeline construction should be confirmed before permit requirements are deemed to have been met. There were at least five isolated areas of Pueblo goldenweed (*Oönopsis puebloensis*), an imperiled species (Global Rank G2), documented in 2011 prior to pipeline construction. The Pueblo County 1041 Permit Quarterly Construction Report states that a "population of Pueblo Goldenweed was temporarily relocated during construction. They have been placed back in their original location during revegetation activities." Due to the sensitivity of this species, its continued existence on the ROW should be considered a second minimum condition of meeting the permit requirements. We did not observe any Pueblo goldenweed plants on the SDS pipeline ROW during our site visits.

2) Walker Ranch is not heavily grazed or overgrazed, contrary to the assertions of Drs. Roath, Redente, and Buckner. Five lines of evidence support this finding:

a) If Walker Ranch were heavily grazed or overgrazed, highly desirable forage plants would not be either common or abundant. In fact, highly desirable cattle forage plants including four-wing saltbush (*Atriplex canescens*) and winterfat (*Krascheninnikovia lanata*) are common or frequent on undisturbed areas of Walker Ranch adjacent to the SDS pipeline ROW and portions of the ranch that are protected by conservation easements. Furthermore, such plants do not show signs of heavy browsing, such as being severely hedged. Three baseline reports for tracts of Walker Ranch ½ a mile to the west of the SDS ROW that have been protected by conservation easements state that other desirable forage plants, including western wheatgrass (*Pascopyrum smithii*), New Mexico feathergrass (*Hesperostipa neomexicana*), Indian ricegrass (*Achantherum hymenoides*), bottlebrush squirreltail (*Elymus elymoides*) and four-wing saltbush (*Atriplex canescens*) are common on the respective tracts. Furthermore, certain less-desirable forage plant species, such as ring muhly (*Muhlenbergia torreyi*), that would be expected to proliferate in the face of heavy grazing, were not noted on the conservation easements.

b) Noxious weeds are sparse on Walker Ranch. If Walker Ranch were heavily grazed or overgrazed, noxious weeds would be present and mostly likely common. During our site visits on the portion of Walker Ranch along the SDS pipeline ROW, we observed only two noxious weed species, tamarisk (*Tamarix ramosissima*) and puncturevine (*Tribulus terrestris*), per the State of Colorado noxious weed list. It is unusual to find only two

species of noxious weeds on low-elevation ranchland as large as the SDS pipeline ROW. We did not observe any noxious weed species, such as musk thistle (*Carduus nutans*), Scotch thistle (*Onopordum tauricum*), Russian knapweed (*Acroptilon repens*), hoary cress (*Cardaria draba*), or houndstongue (*Cynoglossum officinalis*) that are commonly found in Pueblo County. Typically, noxious weeds and other opportunistic plant species colonize and proliferate when the soil surface is disturbed. In the areas we surveyed, this has not happened off the SDS ROW at Walker Ranch.

c) Numerous awards, certificates, recognitions, and commendations have been conferred on Gary Walker in recognition of his exemplary management of Walker Ranch[1]. In 2014 alone he received the Leopold Award presented by the National Resources Conservation Service and the Colorado Cattlemen's Association, the Land Stewardship Award presented by The Wildlife Society, and a commendation by the Colorado House of Representatives for his conservation work. It is doubtful that these organizations would have bestowed such recognitions if Walker Ranch were heavily grazed or overgrazed, because the condition of the ranch would not have warranted them.

d) Eight tracts of Walker Ranch have been permanently protected by conservation easements held by The Nature Conservancy. The conservation easement for the portion of Walker Ranch that lies nearest to the SDS pipeline ROW states, among other things, that "the Property currently remains in a substantially undisturbed, natural state and has significant open-space and ecological values and provides significant relatively natural habitat for native plants and wildlife." This statement directly contradicts the contention that Walker Ranch is heavily grazed or overgrazed. To the contrary, the baseline reports document that these three tracts of Walker Ranch have great conservation value (see Major Finding #5 below). Furthermore, it is difficult to believe that The Nature Conservancy would have been willing to serve as the holder of the conservation easements if the Walker Ranch were heavily grazed or overgrazed, because the condition of the ranch would not have warranted permanent protection.

e) There were no stock on the ranch for most of the period between 2005 and 2011 because the Walkers are opposed to running livestock during drought (Figgs 2014).

[1] 1988, 1989 and 1990: "Bill Gray Memorial Hunting Awards" by the Safari Club International
1998: Runner-Up for "Colorado Division of Wildlife (CDOW) Wildlife Landowner of the Year Award"
2004: Recognized by The International Safari Club Museum for his dedication to "Conservation of Wildlife Protection of the Hunter & Education of the Public"
2005: "White House Conference on Cooperative Conservation Award" and "Secretary of Army Certificate of Appreciation"
2006: Fort Carson "Sustainability Champion Award"
2010: Runner-Up for "Colorado Cattlemen's Association Leopold Conservation Award"
2010: Fort Carson "Stainable Progress through Partnerships Award"
2013: Colorado Parks and Wildlife (CPW) "Landowner of the Year Award" Nominated by CPW.
2014: Colorado Chapter of the Wildlife Society "Land Stewardship Award".
2014 Leopold Award. Presented by NRCS, Colorado Cattlemen's Assoc. The Sand County Foundation , Tri-State Electric.
2014 Colorado House of Representatives Commendation for conservation.

3) The SDS pipeline ROW that runs across Walker Ranch included significant areas of cholla and fourwing saltbush shrublands prior to pipeline construction. This is important to serve as a guideline for restoration to the original communities. Two lines of evidence support this:

a) Examination of aerial photographs taken in 2011, prior to pipeline construction, reveal that a significant portion of the ROW was covered with cholla and fourwing saltbush shrubland.

b) Field observations along the pipeline ROW in 2013 and 2014 show that shrublands comprised of cholla and fourwing saltbush, co-occurring with galleta grass and/or blue grama, currently exist on both sides of the ROW along much of its route across Walker Ranch (Figure 1). The pipeline ROW cuts a straight swath through and has fragmented this structurally diverse community.

Figure 1. SDS ROW (foreground), and dense cholla-dominated plant community adjacent to SDS pipeline (background).

4) The prospects for reestablishing canopy cover of shrubs, a critical landscape component[2] that were not included in seeding or transplant operations, on the ROW within a reasonable time frame are remote. Two lines of evidence support this finding:

[2] Cholla (*Cylindropuntia imbricata*) and other shrubs, especially four-wing saltbush and secondarily shadscale (*Atriplex confertifolia*) and winterfat (*Krascheninnikovia lanata*), can serve as nurse plants that facilitate the establishment of desirable plant species. The shade cast by the shrubs provides a more hospitable environment for seedlings than exists on open rangeland. Cholla and other shrubs trap wind-blown snow, dust, and organic matter such as leaves and twigs that decompose and are incorporated into the soil. In arid environments, shrubs like cholla and four-wing saltbush create "islands of fertility" that

a) May 2014 sampling of the shrubs on and adjacent to the SDS pipeline ROW on Walker Ranch showed that the density of shrubs on adjacent, undisturbed land was nearly nine times that on the SDS pipeline ROW (69 plants per acre on the ROW versus 616 plants per acre on adjacent land). This disparity suggests that decades will be required in this harsh environment before the shrub density on the ROW approximates that on the adjacent land.

b) May 2014 sampling on and adjacent to the Fountain Valley pipeline ROW, disturbed three decades earlier, on Walker Ranch showed that the density of four-wing saltbush shrubs on adjacent, undisturbed land was nearly twice that on the Fountain Valley pipeline ROW, and the density of cholla on adjacent, undisturbed land was nearly eight times that on the pipeline ROW.

5) Walker Ranch has substantial conservation value that is not conveyed in the Roath and Redente-Buckner reports. Fragmentation incurred by the ranch as a result of the SDS pipeline diminishes its intrinsic conservation value.

Large patches of natural landscapes are dwindling along the Front Range. When Walker Ranch was still intact it was one of only 34 unfragmented patches of shortgrass prairie larger than 50,000 acres (Rondeau and Menefee 2008). The conservation easements for Walker Ranch state, among other things, that the ranch, being located in the Arkansas Valley Conservation Area, has a "Very High" conservation value in addition to a "High" vulnerability ranking (Neely *et al.*, 2006). This value is reflected in its biological resources including vegetation and wildlife.

- Gary and Georgia Walker worked for over 20 years to have the black-footed ferret (*Mustela nigripes*), a federally listed Endangered species since 1967, reintroduced onto the ranch. In the fall of 2013, 35 black-footed ferrets were released to their new refuge on Walker Ranch by virtue of its high-value habitat (Moorhead 2013).
- One rare plant, the imperiled Pueblo goldenweed (*Oönopsis puebloensis*, G2), was mapped on the prospective right-of-way (ROW) prior to pipeline construction in 2011. In addition, three rare plants have been mapped on at least three of the conservation easements on the property. These species are roundleaf four-o'clock (*Oxybaphus rotundifolius*), Arkansas feverfew (*Bolophyta tetraneuris*), and Pueblo goldenweed (Figgs and Lederer 2007b, 2011).
- In 2005, burrowing owls utilizing a black-tailed prairie dog town were observed in the southern reaches of the proposed pipeline area, both conservation targets (Rondeau and Menefee 2008).
- Native plant communities comprise 99% of cover and the property is in good ecological condition according to three conservation easements performed between 2007 and 2011 (Figgs and Lederer 2007a,b and 2011).

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are highly conducive to the establishment and growth of desirable plants (Garcia-Moya and McKell 1970, Charley and West 1975). See Figure 2.

- Noxious weeds, important because they can undermine the conservation value of any property, are uncommon along the SDS pipeline ROW based on our May 2014 field observations.
- Walker Ranch is dominated by shortgrass prairie, a land conservation priority in Colorado (Neely *et al.* 2006). As such, it offers suitable habitat for burrowing owl, mountain plover, ferruginous hawk, black-tailed prairie dog, swift fox, and triploid checkered whiptail. It also provides habitat opportunities for a suite of large animal species including pronghorn, mule deer, elk, mountain lion, and black bear.

The conservation ethic of Gary Walker is indicated by his numerous awards.[1]

The major impairment of Walker Ranch is the ever-widening, erosive band of the SDS pipeline in the western portion. The ripple effects of erosion off of the ROW continue to diminish the high conservation quality of the land and the greater area. This was predicted several years before pipeline construction, as Rondeau and Menefee (2008) stated that impacts from the pipeline could extend more than 100 yards on either side of the ROW.

The Nature Conservancy (TNC) ranks landscapes according to a Viability or Integrity system based on landscape Size, Condition, and Context (TNC 2008), the four rankings ranging from "poor" to "very good." At 64,000 acres, Walker Ranch is of very good quality with respect to Size. The overall condition of Walker Ranch is good, although erosion and deposition associated with the SDS pipeline threatens portions of Walker Ranch.

The landscape context of Walker Ranch is favorable for conservation, including its areas of shrubland habitat. The nearby Chico Basin Ranch and Fort Carson also contribute to the favorable landscape context for conservation. Chico Basin Ranch is an 87,000-acre area owned by the State Land Board and located about 20 miles east of Walker Ranch. This ranch includes a variety of grassland and shrubland habitats (TNC 2008). Additionally, Fort Carson, a member of the Fort Carson Regional Partnership along with the US Fish & Wildlife Service and TNC, protects the natural habitat of endangered and imperiled species while maintaining an undeveloped buffer around the Army installation. Synergistically the two ranches and the military base increase the conservation value of the region.

SPECIFIC ASSERTIONS AND REBUTTALS FOR "CSU SOUTHERN DELIVERY SYSTEM – GRAZING IMPACT REPORT" WRITTEN BY DR. ROY ROATH (UNDATED)

Several assertions by Dr. Roath refer to a 2011 report by the Colorado Natural Heritage Program (CNHP 2011) describing the preexisting conditions of the proposed SDS work area, *i.e.*, prior to construction. The report was prepared in conjunction with ESCO Associates Inc., of which Dr. David Buckner is owner and Senior Plant Ecologist.

Assertion: Page 2, Paragraph 5
Dr. Roath asserts that the 2011 CNHP report "indicates that the combination of prevailing drought conditions and likely history of heavy, season-long grazing had reduced all of the

reported conditions to early seral conditions. This means that many or most of the expected high-quality/preferred grazing species were dramatically reduced in the area."

Rebuttal: A long-term history of grazing, not Walker Ranch management, may have affected plant-community composition region-wide. Season-long grazing does not now occur at Walker Ranch. Last, Roath misquoted the CNHP (2011) report.

Southeastern Colorado has a long history of cattle grazing. In 1866, Charles Goodnight and Oliver Loving began moving cattle from Texas to Denver along what became known as the Goodnight-Loving Trail. The Trail more or less paralleled the current route of I-25 and ran through what is now Pueblo. Thus, it is likely that what is now Walker Ranch experienced extended periods of cattle grazing for the remainder of the 19th Century and into the first half of the 20th Century. Extended grazing during that time probably depleted desirable cool-season grasses in the region (Duke Phillips, Chico Basin, pers. comm.). We believe that the current scarcity of cool-season grasses, such as western wheatgrass (*Pascopyrum smithii*) and bottlebrush squirreltail (*Elymus elymoides*) near the SDS pipeline ROW reflects this history of grazing regimes, and that recent grazing regimes of recent decades have not depleted cool-season grasses on Walker Ranch.

We agree that prevailing drought has reduced forage quantity and range condition. We disagree that season-long grazing is responsible for the current range condition. Gary Walker uses a rotational grazing approach to cattle management and does not graze his cattle for an entire season on the same pasture. Cattle are moved from one pasture to another based on forage availability. Generally speaking, cattle spend less than a month in a particular pasture. Furthermore, Mr. Walker never uses a stocking rate that is more than 50-55 acres of land per animal unit month (Gary Walker, pers. comm.), which is much less than the average for comparable soils and precipitation in the local area. In our opinion, the livestock forage potential along the SDS pipeline is inherently low due to intrinsic environmental conditions.

Last, Dr. Redente misrepresented the 2011 CNHP report. It is in the very last sentence of the CNHP (2011) document that the authors make a solitary reference to grazing. This final sentence reads, "Historical season-long grazing of vegetation by livestock in the S3 portion of the route has also strongly limited the extent of vegetation cover." First, note that CNHP does not make mention of "heavy" grazing *per se*, as asserted by Roath. Second, we submit that, if it were the position of CNHP that recent grazing practices had limited the successional status of these communities, this opinion would have been highlighted at the beginning of their assessment and would not have appeared as an isolated comment in the last sentence of the report. Thus, Dr. Roath's assertion – that the CNHP (2011) report diagnosed heavy, season-long grazing as the cause of low vegetative cover along the pipeline – is inaccurate.

Assertion: Page 3, Paragraph 1

Dr. Roath asserts that, "Additionally, the pre-existing conditions, as reported by the CNHP report of 2011, showed very low ground cover resulting in poor watershed conditions."

Rebuttal: CNHP (2011) did not conclude that watershed conditions were poor. This is Roath's second-hand interpretation of the other study's data.

This notwithstanding, if we assume that watershed conditions on Walker Ranch were indeed poor, these conditions would be further impetus to build the SDS pipeline in such a way as to follow topographic contours and not in a straight longitudinal line that is forced to run up- and downhill. As built, the pipeline is straight and does not follow topographic contours. Following the contours, while costing more, would have increased the likelihood of successful revegetation and would have reduced the likelihood of substantial soil erosion, in part because directing water runoff from a disturbance that parallels landscape contours presents less erosive potential than from a disturbance that runs across the landscape in a straight line irrespective of the surrounding topography.

Assertion: Page 3, Paragraph 2

Dr. Roath "The proof of drought versus grazing is often the rate of recovery once management changes. The land areas of focus here were rested (not grazed) for approximately three years, to the present time. My evaluation is that though there is some indication of shrubs showing some leader growth and little to moderate growth of grasses and herbaceous plants of lower seral communities; the vigor and apparent health of the any of [sic] the more desirable species is largely absent."

Rebuttal: Given the severity of the drought, a more plausible demonstration of the influence of drought vs. grazing is how desirable forage plants respond once the drought breaks and conservative grazing resumes.

Dr. Roath himself acknowledges (p. 5, paragraph 2) that the environment on the SDS pipeline on Walker Ranch is "extraordinarily harsh." Given the severity of the current drought in southeastern Colorado generally and on Walker Ranch in particular, it is difficult to understand how desirable forage plants will respond simply because grazing is altered (in this case, grazing was terminated in 2011). Desirable forage plants have limited opportunity to grow with depleted soil moisture regardless of the grazing regime. This point is corroborated by Figgs (2014), who states that drought is the primary determinant of rangeland conditions in southeast Colorado.

Assertion: Photograph, Page 4

The caption reads, "Salt flat ESD/Limon soils on Rangelands adjacent to the Easement – Very low soil cover and poor plant vigor".

Rebuttal: Herbaceous plant cover is sparse because of erosion and sediment deposition, not because of the grazing regime.

Established shrubs as shown in the photograph are generally taller and are more resistant to erosion than herbaceous plants and do not generally suffer mortality, as herbaceous plants do, in response to erosion and sediment deposition. Note the erosion channel in the foreground of the photograph as evidence of this phenomenon. We observed a number of such sites along the SDS pipeline ROW on Walker Ranch. It is plainly evident in the field that the source of the water that caused the erosion and deposition is runoff from the SDS pipeline ROW.

Assertion: Page 4, paragraph 2
Dr. Roath claims that desirable plant species are more frequent on ungrazed areas on the SDS pipeline in work area S2 (south of Walker Ranch) than work area S3 (on Walker Ranch).

Rebuttal: S2 has experienced less erosion and redistribution of soil than S3, which is the part of the SDS pipeline on Walker Ranch.

Based on "windshield observations" we made on portions of the S2 portion, Dr. Roath's description of vegetation on S2 may be true. It is important to note, however, that the portions of the SDS pipeline we observed in area S2 are much flatter than those on most of the Walker Ranch portion of area S3. Segments 1-4 of the SDS pipeline ROW (with Limon and Heldt series soils) have experienced massive deposition of sediment eroded from portions of the ROW further north. The sediment deposition has impeded the establishment and growth of desirable plants in Segments 1-4. Furthermore, recent regrading by the reclamation contractor not only confirms that sediment deposition on those segments has been considerable, but has once again disturbed most of the ROW in Segments 1-4. We did not observe evidence of comparable sediment deposition on the S2 portions of the ROW, substantiated by Keammerer (2013). Thus, it would not be surprising if the S2 portions have higher frequency of desirable plants than the comparable portions of the SDS pipeline on Walker Ranch.

Assertion: Pages 2-4
Dr. Roath makes repeated references to the CNHP (2011) report.

Rebuttal: CNHP (2011) did not adhere to accepted scientific methodology in their field sampling protocol.

In Appendix D of the report, "Established Vegetation Sampling Protocol," CNHP (2011) specifies that, "Samples will be placed in locations representative of the general vegetation type and its condition. Areas of high disturbance and abundant presence of weeds will be avoided." Standard scientific methodology requires random placement of all sample locations in order to make valid inferences about a larger population of interest, which in this case is the entire SDS pipeline ROW on Walker Ranch.

Assertion: Page 5, paragraph 2
Dr. Roath asserts, "… it is my observation that the reclamation action was remarkably successful in its relative success; [sic] given the extraordinarily harsh environment. It is clear that many plants are in the process of establishing and will only increase in their density and forage yield."

Rebuttal: Short-term results do not indicate nor guarantee long-term success.

We agree that the environment along the pipeline is "extraordinarily harsh." We also agree that establishment of native grasses is promising at the present time on parts of the pipeline ROW north of Steele Hollow. However, data collected from the nearby Fountain Valley pipeline illustrate that short-term results do not indicate nor guarantee long-term success. The Fountain Valley pipeline was constructed in the early 1980s near the SDS pipeline, also on Walker Ranch. The Colorado Natural Heritage Program established four test plots on the Fountain

Valley pipeline in 2011 to determine which of two watering regimes would be more successful at aiding establishment of perennial grasses. Vegetation data were collected in the irrigated test plots at the end of the 2011 growing season. The average frequency of native grasses was 56% (Rondeau 2012). Re-sampling the same test plots in May 2014 revealed that the average frequency of native grasses had decreased to 8.9%, which was lower than that on adjacent land (13.9%). Thus, there is no assurance that vegetation resulting from a year or two of irrigation will persist for the long term in this "extraordinarily harsh" environment or even equal that on adjacent undisturbed land. For details of the vegetation sampling, see Appendix 1.

Assertion: Page 5, paragraph 3
Dr. Roath asserts "The current low stocking rates are reflections of the low forage standing crop and poor plant vigor."

Rebuttal: The current low stocking rate has nothing to do with forage availability.

In fact, the stocking rate is zero. Cattle were removed from the Walker Ranch pastures that include the SDS pipeline in 2011 to avoid conflicts with the cattle during pipeline construction and to allow the vegetation on the SDS pipeline ROW ample opportunity to become established.

Assertion: Page 7, paragraph 1
Dr. Roath states, "The pipeline vegetation will be inordinately attractive to livestock when they are reintroduced to the pastures."

Rebuttal: It has been our observation that recently established desirable plants are inordinately attractive to grazing or browsing animals. Thus, it will be imperative for Gary Walker to manage livestock grazing carefully once the plants on the ROW have attained sufficient maturity to tolerate moderate defoliation and to not be pulled from the ground by grazing animals. He intends to rotate cattle use of the three pastures that harbor the SDS pipeline ROW and to stock at a conservative level in order to protect the plants in the ROW from overgrazing.

Assertion: Page 7, paragraph 1
Dr. Roath states, "The three pastures with pipeline right-of-way in them could easily be incorporated into a simple rotation with one being grazed for no more than 20 days in the spring ending by May 1-20 and the other two being grazed sequentially for 20 days each in the fall."

Concurrence: We agree that a rotational grazing scheme would help prevent overgrazing of the desirable grasses on the pipeline ROW.

SPECIFIC ASSERTIONS AND REBUTTALS FOR "EXPERT REPORT OF EDWARD F. REDENTE, PH.D. AND DAVID L. BUCKNER, PH.D.," DATED MAY 21, 2014

Assertion: Page 6, paragraph 6
"Samples were placed at random points in conformance with the Technical Memo 1 (pages 7 and 8) associated with the Pueblo County Protocol (CNHP, 2012)."

Rebuttal: We are unclear on the version of the Protocol to which the authors actually refer, which could have significant implications for evaluating the methodologies and interpretations of the Redente/Buckner report.

In viewing the references for CNHP (2012) as cited above, Drs. Redente and Buckner cite the title as, "Pueblo County Revegetation Cover Establishment Protocol for the Southern Delivery System Pipeline Project." This is in fact the title of both CNHP (2013) and CNHP (2014), but not of CNHP (2012). The CNHP (2012) reference should qualify the document as a Proposed Protocol (see References in this document). All three CNHP protocols have substantial differences.

The confusion as to which CNHP study was used to inform other studies raises another issue, pertaining to the Keammerer (2013) vegetation assessment along the SDS ROW. This report refers only to "performance standards," which we presume were from CNHP (2012) or CNHP (2013) (*i.e.*, not CNHP [2014]) because it was completed in 2013. Both CNHP (2012) and CNHP (2013) differ in their definition of Creditable Vegetation Cover (from Technical Memos 3 in each document).[3] We are uncertain how or whether to reconcile Keammerer's (2013) findings with those of Redente and Buckner, because the standards of acceptable species have changed every time. Furthermore, CNHP (2014) is different still than both of the earlier versions.[3]

Last, regardless of the Protocol used, both versions indicate that samples are to be placed in "locations representative of the general vegetation type and its condition." This is not random placement and does not adhere to accepted scientific methodology. See our comments above in response to their "Assertion, Pages 2-4."

Assertion: Pages 7-13

Pages 7 – 13 contain a primer on revegetation. We generally agree with the statements of Dr. Redente in these pages. On page 9, Dr. Redente states that "Steep slopes (2h:1v and steeper [sic] and long uninterrupted slopes can be difficult to reclaim because of access, instability, and potential for erosion. In dry regions, slopes that are south and west facing are typically drier and

[3] Creditable Vegetation Cover as defined in the aforementioned documents are as follows:
CNHP (2012): "Cover provided by plants included in the Colorado A- or B-list of noxious plant species, if any, will not be acceptable in the evaluation of cover. Cover by all other plants will be acceptable in assessment of adequate revegetation cover."
CNHP (2013): "Cover provided by plants included in the Colorado A-, B-, or C-list of noxious plant species, if any, will not be acceptable in the evaluation of cover. Cover by all other plants will be acceptable in assessment of adequate revegetation cover, except as follows: cover by non-native annual/biennial plants in excess of half of the vegetation cover measured (i.e., any amount over 50 percent relative cover) will not be counted toward establishment of proof of successful revegetation."
CNHP (2014): "Cover provided by plants included in the Colorado A-, B-, or C-list of noxious plant species, if any, will not be acceptable in the evaluation of cover. Cover by all other plants will be acceptable in assessment of adequate revegetation cover, except as follows: cover by non-native annual/biennial plants in excess of the relative cover by those plants in the pre-construction sample data will not be counted toward establishment of proof of successful revegetation."

more difficult to reclaim than north and east facing slopes because of lower soil water conditions and less soil development."

Rebuttal: The landscape positions represented on much of Walker Ranch, *i.e.*, south-facing slopes, are precisely those identified by Dr. Redente as being "more difficult to reclaim." Much of the SDS pipeline ROW on Walker Ranch is located in a dry region and is characterized by long, uninterrupted, south-facing slopes that run parallel to (not across) the pipeline ROW.

Assertion: Page 14, paragraph 2
Dr. Redente asserts that "The first year of plant establishment following seeding in 2012 is showing favorable establishment of perennial species through the seeding process."

Rebuttal: There is no correlation between short-term results and long-term success (see note above addressing Page 5, paragraph 2 of the Roath report).

The data we collected on the Colorado Natural Heritage Program test plots on the Fountain Valley Pipeline are a case in point. The frequency of native grasses (seeded or otherwise) dropped from 56% to 8.9% in two years. We agree that some areas of the SDS pipeline on Walker Ranch, especially north of Steele Hollow, are showing promise in terms of seeded perennial herbaceous species.

Assertion: Page 14, paragraph 2
Dr. Redente asserts that "Most weeds that are present are not occurring at a high enough density to have either a positive or negative effect on the establishment and growth of perennials [sic] species."

Rebuttal: Establishment and growth of native grasses on the southernmost segments of S3 is inhibited by nonnative species.

While much of the pipeline meets the description in Redente's report, the density of introduced annual plants, including Russian thistle (*Salsola australis*), halogeton (*Halogeton glomeratus*), and kochia (*Bassia sieversiana*), in the fall of 2013 was high enough on the southernmost segments (1-4) to retard the establishment and growth of the seeded native grasses. Furthermore, these exotic plant species, especially Russian thistle, form tumbleweeds and spread seeds on Walker Ranch downwind (typically to the east) of the SDS pipeline ROW, thus potentially increasing nonnative cover off of the ROW.

Assertion: Page 14, paragraph 2
Dr. Redente asserts that "The nurse plant function of Russian thistle is similar to the role being fulfilled by shrubs and tree cholla (*Cylindropuntia imbricata*) in areas on the Walker Ranch where grasses are established under the protection of woody plants."

Rebuttal: There are significant differences in the ecological roles of Russian thistle and cholla.

While some nurse plant effect might occur under Russian thistle plants, important differences do exist between Russian thistle and cholla. First, Russian thistle is an annual, which breaks at ground level in the fall or winter to form a tumbleweed, while cholla is perennial and does not break. Second, cholla is taller and wider with a canopy shape similar to an open umbrella, which is much different than that of Russian thistle. These two factors – the perennial presence of cholla and its protective shape – combine to create on open understory that is often conducive to native grass establishment (Figure 2). The photograph looks toward the east. Native grasses have established under the north-facing, somewhat shaded (left) side of the cholla plant. Native grasses are much more abundant under the cholla than in unprotected areas. Russian thistle does not provide sustained opportunities for native grass establishment.

Figure 2. Looking east at dense green grass on the north side of a cholla.

Assertion: Page 14, paragraph 3

Dr. Redente asserts that, "The techniques used by CSU to revegetate the SDS easement though the Walker Ranch were correct and appropriate for the site conditions created by construction activities and for the environmental conditions of the area. The revegetation specifications that were followed for seed bed preparation, seeding, mulching, and irrigation represent the industry standard. The techniques used will result in the establishment of a diverse plant community along the S3 easement that is native to the area, will stabilize the soil from wind and water erosion, and will meet a land use goal of domestic cattle grazing"

Rebuttal: We disagree entirely with these assertions for the reasons outlined below.

First, the final grading did not replicate the original landscape grade that existed prior to pipeline construction. The following points (a) through (c) were communicated to CSU by Gary Walker in 2012, who requested additional grading to rectify the situation. Mr. Walker's specific requests were not heeded, at least initially. Furthermore, the reclamation contractor, Western States Reclamation, deemed the grading acceptable, in spite of Mr. Walker's advice

that the grading would lead to major erosion problems. The problems articulated by Mr. Walker included:

(a) Overland flow in many areas changed from sheet flow running across the future pipeline ROW to channelized flow running down the pipeline ROW, creating significant erosion and sediment deposition both on and off the pipeline ROW.

(b) The crown along much of the pipeline ROW causes rainfall to run off rather than infiltrate into the soil, thereby limiting native grass establishment along the middle of the pipeline ROW.

(c) To date, the revegetation techniques applied to grades that did not replicate pre-construction elevations have not "stabilize[d] the soil from wind and water erosion". To the contrary, major erosion has occurred on and adjacent to the pipeline ROW in S3. As a testament to this situation, the reclamation contractor has expended considerable energy and time installing various treatments to reduce soil erosion.

Second, a key error of CSU was the failure to realize that industry-standard techniques for vegetation reestablishment are not appropriate for the specific conditions of Walker Ranch. This reality was reflected in the wide disparity of bids for the reclamation work on Walker Ranch. Locally based contractors who were familiar with the conditions of Walker Ranch knew that they could not produce the desired level of revegetation and limit soil erosion at a low price. Among the five bids, CSU ultimately selected the reclamation contractor who offered to do the work at the lowest price of $1.7 million. The others ranged from $2.9 to $4.5 million. The huge spread in bid amounts should have alerted CSU that the low bid was suspect.

Third, seeds or container-grown transplants of shrub species, a dominant component of the species assemblage in the Walker Ranch ecosystem, were not included in the post-construction reclamation. Note that Specification C-9 (Site Restoration) of the Pueblo County 1041 permit number 2008-002 states that, "Applicant shall provide Pueblo County residents with replacement vegetation and property to match pre-existing conditions or better." A key feature of the portion of Walker Ranch through which the SDS pipeline runs is the preponderance of shrubs, primarily cholla and four-wing saltbush, as well as winterfat. The seed mix applied to the SDS pipeline on Walker Ranch lacked shrub seeds, a grave shortcoming that appears to have been an ill-advised way to cut costs. Failure to actively incorporate shrubs in the revegetation process has retarded the rate of shrub establishment. Shrubs are not only integral to the desired plant species assemblage but also facilitate the establishment of desirable grasses and forbs (Figure 2).

Fourth, the mulching as installed was only marginally effective. Given the strong prevailing westerly winds on Walker Ranch, it should be obvious that straw mulch would be redistributed quickly, much of it blowing off he pipeline ROW. In fact, Keammerer (2013) noted that mulch was substantially redistributed on the SDS pipeline on Walker Ranch. We surmise that the mulch was not adequately crimped, such that it would have firmly bonded with the underlying

soil and would have withstood strong winds. Perhaps the seedbed was too hard for crimping to be properly implemented and/or perhaps the mulch was not properly applied.

Fifth, the irrigation system used on the SDS pipeline on Walker Ranch is lacking in at least two respects:

(a) It was installed aboveground, making it more susceptible to breaks, photodegradation, and consequent down times for repair.

(b) The pattern of the irrigation did not provide complete coverage of the pipeline ROW. We believe that the generally sparse perennial grass cover along the middle of the pipeline ROW was partly a result of the poorly designed irrigation system, which watered the ROW margins but not the interior space of the ROW (Figure 3). The insufficiencies of the irrigation system are exacerbated by the crowning of the pipeline as discussed above (part [b] in the grading discussion, rebuttal to Page 14, paragraph 3).

Figure 3. Looking north from center of ROW, Walker Ranch.

Assertion: Page 15, paragraph 1

Dr. Redente states, "The [seed] mixtures did not include shrub species for two reasons. The first reason is that the plant community that existed in this area prior to settlement and intensive livestock grazing was a grassland community..." "Second, with the presence of shrubs and cacti in the areas adjacent to the easement, it is more likely than not that shrubs and cacti will colonize the easement though natural processes of seed dissemination and plant establishment. Visual observations in October 2013 along the S3 easement on the Walker Ranch in October 2013 showed numerous four-wing saltbush (*Atriplex canescens*) seedlings (many six to twelve inches

tall) present and this observation is supported in plant cover data collected in September 2013 and presented in this report."

Rebuttal: There are four points to this rebuttal.

First, Redente's statement that the original plant community was a grassland is from a BLM survey done in 1866, not a description of the ecosystem that was actually disturbed, and is thus irrelevant.

Second, the 1041 permit (C-9) requires that the "vegetation cover shall be of the same seasonal variety native to the area of disturbed land, or species that support the post-construction land use." Post-construction land use requires that shrubs be a key component of Walker Ranch because shrubs were integral to pre-construction vegetation along the pipeline ROW. Reclamation is obligated to populate the ROW with shrubs as dictated by the permit and not to rely solely on colonization from the soil seed bank.

Third, it does not seem plausible that shrubs will "colonize the easement through natural processes of seed dissemination and plant establishment." This is excessively optimistic based on visual observation of the nearby Fountain Valley pipeline ROW. Four-wing saltbush and cholla along the pipeline ROW are generally sparse 30 years after the pipeline was constructed.

Fourth, Dr. Redente's opinion as to why shrub seeds were excluded from the seed mix is not shared by his coauthor, Dr. Buckner, who asserted that shrub (and forb) seeds would introduce foreign genetic material (see discussion below regarding Page 23, paragraphs 3 and 4). The fact the two differ on this particular issue dilutes the persuasiveness of either author's argument.

Assertion: Page 15, paragraph 2
Dr. Redente states that mulch "does not always result in measurable improvements in plant establishment ..."

Rebuttal: Mulch is essential in this exceptionally hot and dry environment.

Of course, it is true that mulch does not always (*i.e.*, without any exceptions anywhere under any circumstances) lead to measurable improvements in plant establishment. Given the local environmental conditions of Walker Ranch and the presumed desire by CSU to achieve satisfactory vegetation establishment in a reasonable time frame, mulch is essential.

Assertion: Page 15, paragraph 4
Dr. Redente states that, "The use of irrigation by CSU represents an extra effort to ensure vegetation success in a relatively short time frame. Revegetation would be successful along the easement without irrigation; the only difference is that plant establishment takes longer without supplemental water. The irrigation system that was designed, installed, and used on the S3 easement was appropriate and highly effective. Visual observations made in October 2013 indicate that there were areas where water coverage was less in the center of the easement, but

these areas were isolated and although plant cover was lower than in other areas, this result will not lead to revegetation failure"

Rebuttal: Irrigation should be considered a minimum effort towards revegetating the SDS pipeline area, and the system as installed had major shortcomings.

Given the contentious nature of the SDS pipeline and given the local availability of water owned by the City of Colorado Springs, it is beyond belief that CSU might have opted to forego the use of irrigation to speed plant establishment. Given an unlimited period of time, *i.e.*, on the order of decades, adequate revegetation may eventually be successful. But during this recovery, soil erosion would be unacceptably high due to the improper grades and the sparse plant cover along the SDS pipeline ROW. The pipeline ROW would also be a visual eyesore that would diminish the market value of the entire Walker Ranch.

Regardless of the "extra effort" represented by the installation of an irrigation system, the system itself has major shortcomings that have limited its effectiveness in promoting plant establishment (noted above under the fifth point under the Rebuttal to Assertion on p. 14, paragraph 3). These flaws include its aboveground installation and its poor coverage of the central area of the ROW. We appreciate Dr. Redente's acknowledgement that there were areas in the center of the easement that received less water coverage, but we disagree that these areas are "isolated." Rather, based on our May 2014 observations and supporting photographs, these areas of low vegetation cover on the pipeline ROW are the norm.

Assertion: Page 16, paragraph 3
Dr. Redente asserts that, "There is no validity to the concern raised by Walker Ranches that grooves or drill rows along the easement are preventing sheet flow and could create major erosion and prevent water from reaching certain areas to support plant establishment. In addition, a comparison of topographic contours between 2010 (pre-construction) and 2014 (Critigen 2014) along the S3 alignment on the Walker Ranches are not different enough to impede water flow across the easement …."

Rebuttal: Visual observations during May 2014 confirm that, in fact, grooves and, to a lesser extent, drill rows are preventing sheet flow and are creating channel flow.

The grooves channeled runoff water during the modest precipitation events in August and September 2013 and resulted in gulleys. Although many of the grooves and gulleys have been graded by the reclamation contractor subsequent to the fall of 2013, many gulleys still remain. Further, it seems that if the gulleys did not exist, the reclamation contractor would not spend time and money repairing them, which in fact it has. Similarly, if channeling and subsequent erosion had not been established and observed, the reclamation contractor would not have installed highly engineered and expensive erosion control structures on the SDS pipeline ROW on Walker Ranch (such as those in Segment 8).

Assertion: Page 16, paragraph 3
"The notion that the presence of drill rows are [sic] preventing sheet flow and in some way this is preventing water from reaching certain areas either on or off the easement for plant

establishment and growth has no merit. Plant establishment and growth is almost totally reliant on precipitation...and not on water movement across the soil surface from one area to another."

Rebuttal: If this were true, plant biomass would be more or less equally distributed across the landscape and would not concentrate in low-lying areas, rills, or depressions.

Cursory visual inspection quite clearly negates Dr. Redente's claim that plant establishment and growth is independent of overland flow. For example, alkali sacaton (*Sporbolus airoides*) grows preferentially in relatively flat areas where stormwater runoff collects.

Assertion: Page 17, paragraph 2
Dr. Redente states that "The extreme precipitation events that occurred in the area in late summer/early fall of 2013 created drainage pathways in multiple places across the easement on the Walker Ranch that would have taken decades to establish under normal precipitation conditions. It is important to recognize that this process of channel development through erosion and sedimentation is a large-scale natural process and that the presence of the easement is not the cause of erosion and sedimentation either on or off the easement."

Rebuttal: The "extreme" precipitations events to which Dr. Redente refers were not, in fact, extreme events (Parzybok 2014).

The major lesson from these precipitation events is this: even relatively low precipitation events produce major erosion along the vulnerable SDS pipeline ROW on Walker Ranch.

Although erosion is a natural process, a key issue here is the rate and locations at which erosion and channel formation are occurring (and note that the "drainage pathways" referred to by Dr. Redente are more accurately characterized as gulleys and rills [Keammerer 2013]). Visual observations along the SDS pipeline ROW on Walker Ranch show clearly that sheet flow has been converted into channel flow on the pipeline easement. Dr. Redente seems to be saying that the bare soil on the easement did not contribute to the observed erosion. This statement is inconsistent with a fundamental principle of watershed management, namely that soil erosion increases in proportion to the abundance of bare soil. The current movement of water on the easement is not natural, because the grading of the pipeline did not match the ground surface elevations that existed prior to pipeline construction.

Importantly, the redistribution of water, as occurs with diversions off the crowned ROW and through eroding gulleys and rills, will inevitably deprive some plants and plant communities of water. The resulting plant stress may be evident in reduced vigor and possible mortality, which in turn would lead to ongoing erosion.

Assertion: Page 19, paragraph 3
"Native perennial forbs were generally low in abundance providing less than 1% cover...Shrubs and subshrubs provided typically about 1% cover…"

Rebuttal: The CNHP (2011) report was misquoted by Dr. Buckner.

We agree that forbs are generally low in abundance in undisturbed areas, but for the sake of accuracy the CNHP (2011) report referenced for these data report that native perennial forbs were as high as 4% on Cascajo Series Soils, while shrubs and subshrubs were 1.7% on Midway Shale and 2.7% on Limon Series soils. These differences may seem negligible but the actual values are anywhere from almost 2× to 4× the values reported by Dr. Buckner, which in this low-biomass ecosystem can be significant.

Assertion: Page 19, paragraph 3
"Cacti, most conspicuously tree cholla (*Cynlindropuntia imbricata*), typically comprised from 1 to 3% cover."

Rebuttal: Based on our own field observations, trained visual estimates, and aerial photographs, it seems implausible that cholla comprises such a minor proportion of the vegetative cover in shrub-dominated areas of the ROW. See Figure 1.

Due to time constraints the data to support this contention are currently unavailable, but we suspect that the non-random placement of transects in in "locations representative of the general vegetation type and its condition" may have biased these results to reflect erroneously low cholla numbers (see discussion above on p. 10, regarding the Assertion made on Page 6, paragraph 6).

Assertion: Page 20, paragraph 2
"Given the very strong domination of blue grama, and the absence of cool season perennial grass on the Walker Ranch, it is concluded that continuous grazing has pushed vegetation composition to the state of Blue Grama/Buffalograss Sod; Broom Snakeweed Community." This is in the evaluation of pre-existing conditions, prior to pipeline construction.

Rebuttal: We interpret this Ecological Site Description differently than Dr. Buckner.

His assertion is based on the Ecological Site Descriptions (ESDs) provided by the Natural Resources Conservation Service (www.nrcs.usda.gov), Major Land Resource Area (MLRA) 69, Loamy Plains. First, the Historic Climax Plant Community (HCPC) is dominated by the species he named – western wheatgrass, blue grama, four-wing saltbush – but also galleta grass, which he did not name. We frequently observed each of these species except for western wheatgrass in undisturbed areas near the ROW. Western wheatgrass is common, however, on Walker Ranch one-half mile west of the SDS pipeline ROW (Figgs and Lederer 2007a,b; 2011). Second, we did not observe buffalograss as would be expected after periods of continuous grazing without adequate recovery, although admittedly we did observe blue grama. Because three of the four species of the HCPC were well represented in undisturbed areas, it is hasty to conclude that the pre-disturbance landscape had already reached conditions that represent overgrazing.

Assertion: Page 22, paragraph 2
Dr. Buckner states, "In the pre-construction inventory data, blue grama and galleta along with ear muhly are the dominants. Given this and the sparse presence of alkali sacaton and complete absence of western wheatgrass, it is apparent that conditions are somewhere between the state

described in the ESD as Increased Blue Grama/Galleta with Remnant Mid Warm/Cool Season Grasses and Shrubs Community and the yet more deteriorated Blue Grama Sod Community."

Rebuttal: We don't agree with Dr. Buckner's interpretation of either the pre-construction inventory data or of Walker Ranch within the context of the ESD.

First, data of preexisting conditions show slightly different conditions than reported by Dr. Buckner. From CNHP (2011), which provided a description of preexisting conditions along the ROW, the soils in question (Heldt and Razor Series soils) were dominated by blue grama (4%) and alkali sacaton (4%; Heldt); and blue grama (6.14%), galleta grass (3.86%), and alkali sacaton (1.14%; Razor). Ear muhly had a cover of zero (0%) and thus could not have been considered dominant as described by Dr. Buckner. Alkali sacaton had the same coverage as blue grama in Heldt Series soils and thus should not be described as sparse if its equivalent, blue grama, was described as dominant.

Second, the Climax Community described in the ESD is comprised of alkali sacaton, western wheatgrass, blue grama, galleta grass, and four-wing saltbush. Four-wing saltbush was observed on Razor Series Soils at 0.57% cover (CNHP 2011). Thus, all species in the Climax Community but western wheatgrass, as described in the ESD, were observed in the CNHP (2011) report. After continuous grazing, the ESD states that the ecosystem transitions to a community dominated by blue grama and galleta, and ongoing grazing will then convert the system to blue grama sod. The ecosystem we observed at Walker Ranch is nowhere near a blue grama sod plant community. We concede that the system may be in transition from the Climax Community to the blue grama/galleta system with remnants of the other species, but it is not so distressed as to be in a more deteriorated state.

Page 23: "Results from First Year Vegetation Monitoring in 2013"
The data reported in Dr. Buckner's summary include (1) a range of "acceptable species per square meter" (3.5-5.2), (2) average density of native perennial forb species before and after construction, separated by soil group, and (3) a range of shrub and subshrub density per acre (40-120), which was "estimated to be comparable to pre-existing conditions."

Rebuttal: The data reported do not adhere to the Revegetation Protocol (CNHP 2012, CNHP 2014). Buckner's range of "acceptable species per square meter" offers limited information. It doesn't present averages, measures of variance (*e.g.*, standard deviation or error), sample size, or other conventional parameters when presenting scientific data). Further, "acceptable species" is not defined.

Assertion: Page 23, paragraph 2
"Based on the September 2013 results, cover levels by acceptable species on the portion of pipeline segment S3 on which irrigation began in 2013 were greater than or statistically indistinguishable from the 90% performance standard."

Rebuttal: In contrast to Dr. Buckner's September 2013 data collection along the SDS ROW, Keammerer's (2013) September data collection along the SDS ROW indicated that the performance standard had not been met. This discrepancy should be explained. Furthermore,

Dr. Buckner's judgment is not supported with any data or statistical analysis and therefore is unverifiable.

Assertion: Page 23, paragraph 3
"As per the Protocol, an assessment of the presence of acceptable species was made based on the average number of acceptable species present per square meter. The performance standard was an average of 2.0 acceptable species per square meter."

Rebuttal: The Protocol (CNHP 2012, CNHP 2014) defines a seedling density target of four seedlings per square foot, not two "acceptable species per square meter."

Assertion: Page 23, paragraphs 3 and 4
Forb and shrub seeds were not added to the seed mix "due to concern about the introduction of foreign genomes."

Rebuttal: This principle of genomic contamination was not applied to grasses in defining the seed mix and suggests a double standard.

In addition to the above point, this particular issue could easily be addressed with onsite seed collections. Furthermore, coauthor Redente does not concur with Buckner's stated reasons for this exclusion (see Assertion, Page 15, paragraph 1). The fact the two differ on this particular issue dilutes the persuasiveness of both authors' arguments.

CERTIFICATION AND DOCUMENTATION

We certify that, to the best of our knowledge and belief, the statements made herein are true and correct. Documents supporting the opinions of Drs. Carpenter and Sherrod are included in the materials cited in the References. Additional documents and exhibits may be used at the hearing, including photographs from site visits that were used to support our opinions.

Respectfully submitted,

Alan T. Carpenter, Ph.D.

June 16, 2014
Date

Susan K. Sherrod, Ph.D.

June 16, 2014
Date

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APPENDIX 1
May 2014 Field Observations

The consultants hired by the CSU (CSU), primarily in the reports written by Drs. Redente-Buckner and by Dr. Roath, claim, among other things, that (a) the SDS pipeline right-of-way on Walker Ranch was primarily grassland and not shrubland prior to pipeline construction, (b) establishment of shrubs on the pipeline ROW from the soil seed bank will be sufficient to establish the needed complement of shrubs on the Southern Delivery System (SDS) pipeline ROW in a reasonable time frame, and (c) the progress of vegetation establishment on the SDS pipeline ROW currently meets the vegetation-related standards set forth in the 1041 permit. By implication, CSU could claim that because the vegetation-related standards have already been met, according to the claims in the Redente-Buckner report, CSU has no further obligation with respect to vegetation on the pipeline on Walker Ranch.

Based on previous field observations, we believe that these claims are not correct. The following vegetation measurements support my contention that (a) most of the pipeline ROW on Walker Ranch was shrubland prior to pipeline construction, (b) the current density of shrubs (including new recruits) on the SDS pipeline is far lower than that on adjacent areas along the SDS pipeline ROW, (c) the abundance of native, perennial grasses, forbs, and shrubs on the Fountain Valley pipeline is less than that on adjacent land, and (d) the current density of shrubs on the nearby Fountain Valley pipeline, which underwent similar disturbance three decades ago, indicates that shrub colonization of the SDS pipeline ROW will be similarly very slow if indeed it is occurring.

FOUNTAIN VALLEY PIPELINE

The Fountain Valley water pipeline, constructed in the early 1980s, more or less parallels the SDS pipeline through Walker Ranch. In 2011, the Colorado Natural Heritage Program (CNHP) established test plots along the Fountain Valley pipeline to determine, primarily, what irrigation regime would support establishment of native, perennial vegetation.

The test plots and sampling protocol were established by CNHP as follows:

- 4 test plots were established on the pipeline ROW in 2011.
- Each test plot was 500 × 30 feet with the long axis of each plot running parallel to the pipeline length of the pipeline ROW (generally north – south).
- Each plot was divided into two halves, north and south, with one half receiving 35 days of irrigation and the other half receiving 77 days of irrigation, as specified in Appendix A of Rondeau (2012).
- 100 sampling frames (each 10 cm x 10 cm) were placed in each half of each plot. The frames were located every 2 m along 4 transects located along 4 seed drill rows. Each transect was 50 meters long.
- All plants rooted at least in part in each frame were recorded by plant group (perennial grass, perennial forb, annual grass, annual forb, shrub), because plants were difficult or impossible to identify to species.

Recent visual observations along the Fountain Valley pipeline ROW indicate that shrub establishment has been very slow since the pipeline was constructed in the early 1980s. In addition, observations suggest that the density of desirable perennial plants in the test plots is less than that on adjacent lands. These observations raised concerns that, once irrigationof the SDS pipeline ROW is terminated, the native perennial plants that were previously established might die.

We collected vegetation on the Fountain Valley pipeline in May 2014 to test the following hypotheses: 1) Shrub density on the pipeline test plots is less than that on adjacent areas.
2) The frequencies of native perennial grasses and forbs recorded by CNHP in 2011 on the pipeline test plots are less than those existing now.
3) The frequencies of native perennial grasses and forbs recorded by CNHP in 2011 on the pipeline test plots are less than those on adjacent areas.

Methods

Shrub Density on and Adjacent to the Test Plots
We established 4 long, narrow sub-plots, each 25 meters long and 2 meters wide, in each test plot. The sub-plots were superimposed on each transect used to collect grass and forb data as described below. The center line of each sub-plot was anchored with measuring tape and each of two observers walked next to the tape, one on each side, holding a 2-meter length of PVC pipe. All shrubs whose stems were partially rooted within 2 meters of the center line of each sub-plot were recorded (regardless of size) by species. Overall, we established 4 sub-plots on each test plot and 4 sub-plots adjacent to each test plot or 16 sub-plots per test plot or a grand total of 32 sub-plots for all 4 test plots. We took one digital photograph of each transect looking north from the southern end of each transect.

Grass and Forb Frequency on and Adjacent to the Test Plots
We generally followed Rondeau's (CNHP 2012) methods but reduced the sampling intensity due to time constraints. Thus, we located one 25-meter long transect along a drill row in each quadrant (*i.e.*, NE, NW, SE, SW) of test sub-plot. The beginning point of each 25-meter long transect was determined using a random numbers table (Zar 1974). We placed 10 cm x 10 cm sampling frames at 1-meter intervals along each transect (25 frames per transect) and recorded the presence of each plant rooted at least partially in each frame by plant group (perennial grass, perennial forb, annual grass, annual forb, shrub).

We also established 4 transects, each 25 meters long, west and east of the respective boundaries of the test plots. Each transect on the adjacent land was the same distance north of the southern boundary of the test plot as the comparable transect within the respective quadrant on the test plot. The sub-plots were located 25 meters east or west of the respective boundary of each test plot to ensure that these plots were outside of the Fountain Valley pipeline ROW. We placed 10 cm x 10 cm sampling frames at 1-meter intervals along each transect and recorded the presence of each herbaceous plant rooted at least partially in each frame by plant group. Overall, we established 100 sampling frames in each test plot and 100 sampling frames adjacent to each test plot for a total of 800 frames altogether.

Results

Shrub Density

Four-wing saltbush density was highly variable across sampled areas, but was highest adjacent to rather than on the test plots (Table 1).

Table 1. Four-wing saltbush density on and adjacent to the test plots. Density is expressed as number of plants per acre.

Test Plot Number	On the test plots	Adjacent to the test plots
1	364	324
2	0	162
3	61	313
4	40	101
Average	116	225
Standard Deviation	144	96

Cholla density was highly variable across the sampled areas, but was nearly ten times higher adjacent to the test plots compared to the test plots themselves (Table 2).

Table 2. Cholla density on and adjacent to the test plots. Density is expressed as number of plants per acre.

Test Plot Number	On the test plots	Adjacent to the test plots
1	0	10
2	10	40
3	0	10
4	0	20
Average	2.5	20.2
Standard Deviation	4.4	12.4

Total shrub density was likewise highly variable, primarily due to wide disparities in the numbers of winterfat plants (Table 3). We observed large number of what appeared to be young winterfat plants both on and adjacent to the test plots. Total shrub density was higher adjacent to the test plots than on the test plots.

Table 3. Total shrub density on and adjacent to the test plots. Density is expressed as number of plants per acre.

Test Plot Number	On the test plots	Adjacent to the test plots
1	455	940
2	81	973
3	2457	1217
4	1345	2051
Average	1084	1295
Standard Deviation	916	449

Herbaceous Plant Frequency
Native grass frequency varied across sampled areas, but was generally higher adjacent to rather than on the test plots (Table 4).

Table 4. Native grass frequency on and adjacent to the test plots. Frequency is expressed as the percentage of sampling frames that contained at least one rooted native grass plant.

Test Plot Number	On the test plots	Adjacent to the test plots
1	6.0	18.0
2	14.2	16.2
3	10.2	9.5
4	5.2	11.8
Average	8.9	13.9
Standard Deviation		

Native forb density was highly variable across the sampled areas, but was generally greater on the test plots compared to the adjacent land (Table 5).

Table 5. Native forb frequency on and adjacent to the test plots. Frequency is expressed as the percentage of sampling frames that contained at least one rooted native grass plant.

Test Plot Number	On the test plots	Adjacent to the test plots
1	4.2	2.5
2	5.2	1.2
3	0.0	2.0
4	0.8	0.2
Average	2.6	1.5
Standard Deviation		

Discussion and Conclusions

Cholla and four-wing saltbush are the shrub species on Walker Ranch that serve the greatest ecological role in terms of acting as nurse plants and as creating islands of fertility. The data show that cholla density on the test plots is very low and about eight times lower than on adjacent land. Density of four-wing saltbush shrub on the test plots was about half of that on the adjacent land. We conclude that the colonization of the test plots by shrubs will require many years.

Native grass frequency was greater adjacent to the test plots compared to the test plots themselves, but native forbs were more frequent on the test plots. We conclude that the frequency of native grass and naïve forbs are similar on and adjacent to the test plots.

SOUTHERN DELIVERY SYSTEM PIPELINE

The SDS pipeline was constructed in 2011. Seeding was initiated in the spring of 2012 and, following seeding, irrigation was applied to the pipeline ROW during the 2102 to the potions of

the pipeline north of Steele Hollow. Irrigation water was applied to the entire pipeline ROW n Walker Ranch. The purpose of this field investigation was to determine the progress of shrub colonization of the SDS pipeline on Walker Ranch and to compare the density of shrubs on and adjacent to the SDS pipeline on Walker Ranch.

Methods

We established long, narrow plots on the SDS pipeline ROW and on adjacent areas. We used a series of twenty aerial photographs, demarcated by their matchlines, as segments of S3, each of which would be the location of one plot. We located each plot by aligning it with the southernmost "four-legged" (as opposed to "two-legged") powerline tower within each segment. More specifically, plots were aligned with the northernmost legs of these towers. Exceptions to this were when the ROW next to such towers were recently graded, in which case we moved on to the next tower and which we felt would yield more favorable revegetation results. In this manner, we correlated the locations of all sampling locations with station line distances on the aerial photographs provided by CSU.

The plots were perpendicular to the long axis of the pipeline ROW. The plots were approximately 130 feet long (encompassing the portion of the ROW between the eastern edge of the pipeline access road and eastern edge of the ROW where one can visually demarcate the edge of pipeline disturbance) and 13.1 feet (4 meters) wide. In each of the 20 segments of the SDS pipeline on Walker Ranch, we established one long, narrow plot across the pipeline ROW and one plot of the same dimensions on each side of the pipeline ROW. The plot on the eastern side of the ROW started at the eastern edge of the ROW where the delineation between disturbed and undisturbed vegetation is clearly evident, while the plot on the western side started immediately west of the utility tower that we used to select the location of the sampling location in each segment. Moving the beginning of the plot west of the SDS pipeline ROW to the points immediately west of the relevant utility tower avoided a two-track road that runs along the overhead utility line. The lengths of the plots adjacent to the SDS pipeline were the same lengths as those on the pipeline ROW.

The center line of each plot was demarcated with a fiberglass measuring tape and each of two observers walked next to the tape, one on each side, holding a 2-meter length of PVC pipe. All shrubs whose stems were partially rooted within 2 meters of the center line of each plot were recorded (regardless of size) by species. Thus, we sampled 20 plots on the SDS pipeline ROW and 40 plots adjacent to the ROW.

We took four digital photographs at each sampling location in each plot, as follows: 1) One from the center of the ROW looking north along the ROW, 2) one from the eastern edge of the ROW looking east across the plot, 3) one from the eastern edge of the ROW looking east along the plot on the adjacent, undisturbed land, and 4) one photograph at the western edge of the utility tower and looking west along the plot on the adjacent, undisturbed land.
Results

Results

The average density of four-wing saltbush plants on the SDS pipeline ROW was 26 plants per acre, while that on the adjacent land was 268 plants per acre. The average density of cholla plants on the SDS pipeline ROW was 2.5 plants per acre, while that on the adjacent land was 82 plants per acre.

Discussion and Conclusions

The density of four-wing saltbush plants adjacent to the SDS pipeline was ten times greater than that on the pipeline ROW. The density of cholla plants adjacent to the SDS pipeline thirty-two times greater than that on the pipeline ROW. The strategy of the SDS pipeline reclamation contractor to rely on shrub seeds in the soil seed bank to colonize the pipeline ROW appears to be inadequate.

It is important to note that shrub seedlings that we encountered on adjacent land were not counted, while shrub seedlings we encountered on the pipeline ROW were counted. This removes a possible bias that could have resulted in an artificially high density of shrubs on adjacent land.

Literature Cited

Rondeau, Renee. 2012. Walker Test Plots, 2011: Preliminary Report. Colorado Natural Heritage Program.

Zar, J. H. Biostatistical Analysis. Prentice-Hall, Englewood Cliffs, NJ.

Alan T. Carpenter

Employment

Land Stewardship Consulting, Inc., Boulder, CO (President, June 1998 – present)
Biohabitats, Incorporated, Denver, CO (Senior Ecologist, March 2005 – March 2007)
The Nature Conservancy, Boulder, CO (Land Steward, June 1988 – June 1998)
Colorado State University, Ft. Collins, CO (Research Associate, April 1986 – June 1988)
Utah State University, Logan, UT (Research Assistant, September 1980 – April 1986)

Education

Ph.D., Range Ecology, Utah State University, Logan, UT, 1986
M.S., Water Resources Management, University of Wisconsin, Madison, WI, 1978
M.A., Secondary Education, Catholic University of America, Washington, D.C., 1970
B.S., Chemistry, University of Illinois, Urbana, IL, 1968

Professional Registration

Certified Senior Ecologist vetted by Ecological Society of America

Experience

Mr. Carpenter has extensive experience in natural area inventory, planning and management including twenty-seven years in Colorado. Projects evaluating the biological significance conservation lands; preparing land management plans; conducting invasive plant inventories and management plans; trail planning, construction, and obliteration; and managing nature preserves. Other projects involved wetland and riparian restoration, inventorying and designing monitoring plans for threatened, endangered, and sensitive plants and plant communities, wetlands and riparian areas. Alan is the owner of Land Stewardship Consulting, Inc, and oversees all aspects of the business, including business development, administration, field work, data collection and analysis, and report writing.

Project Experience

Natural Resource Assessments

Denver Natural Areas evaluation, City of Denver Parks & Recreation, Denver, CO. In conjunction with Biohabitats, Inc., Mr. Carpenter conducted rapid biological assessments of selected Natural Areas managed by Denver Parks & Recreation. The purpose of the projects is to inform the Natural Areas staff of significant natural values and management concerns of the lands they manage, as well as recommending practical steps that Natural Areas staff can take to ensure on-going viability of key natural values.

Wetland inventory and evaluation, City of Boulder, Boulder, CO. Mr. Carpenter delineated and mapped approximately 93 wetlands within the City of Boulder to support the City's wetland protection ordinance.

Rapid resource assessments, Boulder County Parks & Open Space, Boulder, CO. Mr. Carpenter participated in rapid resource assessments of ten properties protected by Boulder County Parks & Open Space. The assessments involved inspecting wetlands and riparian areas, searching for threatened, endangered, and sensitive plant species, searching for noxious weeds, and providing management recommendations, among other things.

Riparian vegetation assessment, Colorado Department of Transportation, Denver, CO. Mr. Carpenter collected vegetation data at the Castle Rock conservation bank in 2003 and 2004. The project involved collecting plant species abundance data along temporary transects designed associated with check dams installed by CDOT, at reference and restoration areas, analyzing data, and writing a report. In addition, he conducted an inventory of noxious weeds and prepared maps of the weed occurrences.

Natural resources inventory, Red Rocks Park, Denver, CO. Mr. Carpenter prepared a natural resources inventory of Red Rocks Park. The deliverable was a report that described the significant natural features of the Parrk.

Wetland inventory and evaluation, City of Boulder, Boulder, CO. Mr. Carpenter delineated and mapped approximately 93 wetlands within the City of Boulder to support the City's wetland protection ordinance.

Riparian vegetation assessment, Colorado Department of Transportation, Denver, CO. Mr. Carpenter collected vegetation data at the Castle Rock conservation bank in 2003 and 2004. The project involved collecting plant species abundance data along temporary transects designed associated with check dams installed by CDOT, at reference and restoration areas, analyzing data, and writing a report. In addition, he conducted an inventory of noxious weeds and prepared maps of the weed occurrences.

Critical habitat evaluation, Denver, CO. Mr. Carpenter designed and implemented a project to evaluate the potential of using passive (as opposed to active) restoration techniques to restore habitat of the threatened Preble's meadow jumping mouse at Dellacroce Ranch in El Paso County, CO. The project involved designing a suitable experimental layout, establishing exclosures and paired non-exclosure plots, collecting vegetation data, analyzing the data, and writing reports.

North Kiowa Creek and Richmil Ranch natural resource evaluations, Arapahoe County, CO. Mr. Carpenter conducted the field work for these two open space parcels and wrote short reports that summarized the natural resource values of the properties and made management recommendations related to noxious weeds.

Riparian vegetation assessment, Colorado Department of Transportation, Denver, CO. Mr. Carpenter collected vegetation data at the Castle Rock conservation bank in 2003 and 2004. The project involved collecting plant species abundance data along temporary transects designed associated with check dams installed by CDOT, at reference and restoration areas, analyzing data, and writing a report. In addition, he conducted an inventory of noxious weeds and prepared maps of the weed occurrences.

Wetland inventory and evaluation, City of Boulder, Boulder, CO. Mr. Carpenter delineated and mapped approximately 93 wetlands within the City of Boulder to support the City's wetland protection ordinance.

Conservation Easement Baseline Documentation Reports

Various locations in Colorado for private and public clients. Mr. Carpenter has been the lead author on over 150 baseline reports. Projects typically involve a field visit; interviewing landowner/manager; obtaining and reviewing existing information about wildlife, plants, soils, geology, and water resource; evaluating the conservation values of the subject properties; writing and producing reports.

Invasive Plant Inventory, Planning, and Management

Creating an Integrated Weed Management Plan, Colorado State Parks, Denver, CO. Mr. Carpenter and an associate wrote a handbook that owners and managers of natural lands have used to manage invasive plants. The handbook addressed weed inventory, land management goals, priorities for weed management, weed management techniques, integrated weed management and monitoring and evaluation. Available online at http://parks.state.co.us/NaturalResources/CNAP/Publications/.

Vegetation management plan, Trinidad Lake State Park, Trinidad, CO. Mr. Carpenter and Peter Brown prepared a management plan for invasive plants (Carpenter) and wildfire mitigation (Brown) for the 6,000-acre Park. The invasive plant portion of the project involved a noxious weed inventory, prioritization of weed species and occurrences for management, recommended management techniques for the target noxious weed species, and recommendation for re-seeding areas after weed control activities were implemented.

Integrated noxious weed management plan, Private client, Sedalia, CO. Mr. Carpenter prepared a weed management flan for a 785-acre estate subdivision encumbered by a conservation easement. This involved inventorying noxious weeds on the property, meeting with landowners to understand their goals, and preparing a plan that recommended weed management objectives and control actions that would achieve the owners' goals and objectives.

Integrated noxious weed management plan, US Air Force Academy, Colorado Springs, CO. Mr. Carpenter prepared a weed management flan for the natural portions of the 18,000-acre Academy property. This involved using existing weed inventory data to prioritize weed species and occurrences for control and recommending appropriate weed control and land management measures.

Greenways habitat maintenance program evaluation, City of Boulder, Boulder, CO. Mr. Carpenter and his colleague Claudia Browne conducted an assessment of the effectiveness of noxious weed management and small-scale habitat restoration projects along designated Greenways areas for the City of Boulder. The field work checking the abundance of various noxious weed species at 22 Greenways reaches. The report for the project evaluated weed management on a species by species basis, recommendations for improvements in management for certain weed species, and recommendations to improve the evaluations of small-scale restoration projects.

Natural resources inventory, Red Rocks Park, Denver, CO. Mr. Carpenter prepared a natural resources inventory of Red Rocks Park. The deliverable was a report that described the significant natural features of the Park.

Red Rocks Park Natural Resource Evaluation, Denver Parks and Recreation, Morrison, CO. Documented existing natural resources of Red Rocks Park with particular reference to invasive plant management and social trail closures.

Noxious weed inventory and mapping, Red Rocks Park, Denver, CO. Mr. Carpenter is inventorying and mapping noxious weed occurrences at Red Rocks. He is responsible for the overall technical aspects of the project and ensuring quality control.

Noxious weed inventory and control, San Juan National Forest, Durango, CO. Mr. Carpenter oversaw a three-year weed inventory and control project on the 65,000-acre Missionary Ridge fire area. He was responsible for the overall technical aspects of the project, and ensuring quality control.

Establishing weed management priorities, Bureau of Reclamation, Denver, CO. Mr. Carpenter developed a computerized approach to determining the relative priority of noxious weed occurrences for management. The approach used information from a weed inventory, existing information about the biology of noxious weeds and weed control methods. The output of the model was a rank-ordered list of weed occurrences for management.

Noxious weed inventory and mapping, Lake Pueblo State Park, Pueblo, Denver, CO. Mr. Carpenter, in conjunction with Biohabitats, Inc., is inventorying and mapping noxious weed occurrences in selected areas of Lake Pueblo State Park. Deliverables include computer files that contain information about the mapped occurrences.

Natural Resource Monitoring

Rare plant monitoring studies, The Nature Conservancy, Boulder, CO. Mr. Carpenter designed and implemented monitoring studies of eleven threatened, endangered, and sensitive plant species in Colorado. The studies occurred on private and public lands. The projects typically involved selecting sites for monitoring, developing project goals and objectives, establishing permanent data collection plots or transects, collecting and analyzing plant data, and writing reports.

Plant community and plant species monitoring, The Nature Conservancy, Boulder, CO. Mr. Carpenter developed and implemented monitoring plans for a number of rare plant species and communities various sites around Colorado.

Natural Resource Planning

Resource Stewardship Plans, Colorado State Parks, Denver, CO. Mr. Carpenter was the lead author for resource stewardship plans for twelve Colorado State Parks including Bonny Lake, Boyd Lake, Elevenmile, John

Martin, Lathrop, Mancos, Navajo, St. Vrain, State Forest, Steamboat Lake, Stagecoach, and Spinney Mountain. His work concentrated on writing the introduction, park purpose and significance, water resources, geology and soils, resource conditions and influences, stewardship recommendations, resource monitoring, plus overseeing the work of sub-contractors, and communicating with personnel at State Parks.

Forest ecosystem management plan, City of Boulder, Boulder, CO. Mr. Carpenter participated in a forest ecosystem management plan for the City's open space properties. His work concentrated on incorporating conservation biology principles into the planning process.

Wildlife habitat creation plan, Lakewood, CO. Mr. Carpenter designed a wildlife habitat creation plan centered around a storm water detention pond adjacent to a new regional shopping center for a private client. The project involved establishing project goals, identifying desired plant communities, preparing lists of appropriate plant species for each plant community, preparing drawings and specifications for plant materials, and writing a report.

Wildlife habitat creation plan, Lakewood, CO. Mr. Carpenter designed a wildlife habitat creation plan centered around a storm water detention pond adjacent to a new regional shopping center for a private client. The project involved establishing project goals, identifying desired plant communities, preparing lists of appropriate plant species for each plant community, preparing drawings and specifications for plant materials, and writing a report.

Riparian and Wetland Restoration

Riparian restoration, Ignacio, CO. Mr. Carpenter designed the planting plan for a 3000-foot restoration project for the Southern Ute Tribe on Rock Creek near Ignacio and helped oversee construction, plant installation, seeding and erosion control measures.

a private client. The project involved following the guidelines for wetland mitigation bank establishment in the Federal Register. Briefly, the steps included locating a suitable mitigation site, obtaining an agreement from the landowner to sell the property to the bank, meeting with regulatory agency representatives, preparing a prospectus, responding to comments from public review process, and submitting the revised prospectus to the US Army Corps of Engineers. The prospectus is a lengthy document that sets forth the details of bank operation, e.g., bank goals and objectives, success criteria, number of credits, availability of credits, and wetland improvement activities.

Riparian habitat restoration, El Paso County, CO. Mr. Carpenter designed and implemented a project for the Colorado Department of Transportation to evaluate the potential of using passive (as opposed to active) restoration techniques to restore habitat of the threatened Preble's meadow jumping mouse at ranch in El Paso County, CO. The project involved designing a suitable experimental layout, establishing exclosures and paired non-exclosure plots, collecting vegetation data, analyzing the data, and writing reports.

Trail Planning, Evaluation, and Construction

Trail realignment evaluation, Key Caryl Ranch, Littleton, CO. Mr. Carpenter conducted biological surveys of two planned trail corridors that would reroute segments of existing trails at Ken Caryl Ranch. Particular emphasis was on breeding birds and rare plant species and communities, with more general consideration of wildlife habitat and common plant communities.

Ecological Best Management Practices for trail planning, design, maintenance, and closure, City of Boulder Open Space & Mountain Parks, Boulder, CO. Mr. Carpenter developed ways to reduce environmental impacts associated with trails on City of Boulder Open Space lands.

Trail closure and creation, design and construction, Boulder County Parks & Open Space, Boulder, CO. Served as Technical Advisor to Wildlands Restoration Volunteers to close about 0.8 mile of social trails and build short sections of new trail at Betasso Preserve Open Space.

Skid trails closure, Boulder County Parks & Open Space, Boulder, CO. Served as Technical Advisor to Wildlands Restoration Volunteers to close about 0.6 mile of skid trails resulting from timber thinning operations at Bald Mountain Scenic Area.

Phantom Canyon Trail Design and Construction, Phantom Canyon Preserve, Livermore, CO. Oversaw design and construction of a new trail at the Phantom Canyon Preserve.

Aiken Canyon Trail Design and Construction, Aiken Canyon Preserve, Colorado Springs, CO. Oversaw design and construction of several miles of new trail at the Aiken Canyon Preserve.

Other Experience

Doctoral Dissertation

Investigated the potential of planting sagebrush shrubs in clusters to facilitate the natural process of plant succession on a reclaimed surface coal mine in semi-arid southwestern Wyoming. Also investigated the potential of using a native legume, northern sweet vetch, to boost the nitrogen content of drastically disturbed soils.

Post-doctoral Research

Supervised a seasonal field crew that maintained and collected vegetation and soils data from research plots in the Picenace Basin in northwestern Colorado. Also entered and checked field data and wrote papers for publication. The research project sought to develop methods to reclaim drastically disturbed lands in a semi-arid environment.

Technical Advisor, Wildlands Restoration Volunteers, Boulder, CO. Served a volunteer Technical Advisor for 50 projects dealing with various aspects of upland, riparian, and wetland restoration. Recognized a Technical Advisor of the Year in 2009 and 2011

Professional Associations

Ecological Society of America, Natural Areas Association, Colorado Native Plant Society, Colorado Riparian Association

Selected Invited Presentations

High country grasses. Class taught at Rocky Mtn. Nat. Park, Estes Park, CO; 2002 - 2006.

Mitigation banking and conservation. Presentation at Land Conservation Workshop, US EPA Region 8, Denver, CO, November 6, 2002.

Preparing a land management plan to conserve land. Presentation at the Chatfield Basin Conservation Network, Highlands Ranch, CO, June 25, 2002

To manage or not to manage, that is the question. Presentation at Forest Health Workshop, Bar NI Ranch, Stonewall, CO, February 21, 2001.

Drafting a management plan for conserved properties. Presentation at the Colorado Coalition of Land Trusts Annual Fall Conference, Crestone, CO, September 29, 2000.

Creating an integrated weed management plan. Presentation at National Conservation Training Center, US Fish & Wildlife Service, Shepherdstown, WV, August 29, 2000.

Biological community characteristics. Presentation at Understanding stream dynamics workshop, Loveland, CO; July 15, 2000

Groundwater protection as a stewardship tool for land trusts. Presentation at Land Trust Alliance National Rally, Snowmass, CO; October 17, 1999.

Weed Inventory Methods, Presentation to Bureau of Reclamation, Pest Management Meeting, Denver, CO; April 22, 1999.

Upper Purgatoire River Conservation Plan. Presentation at Thorne Ecological Institute Wildlife Symposium, Glenwood Springs, CO; April 19, 1998.

Management Planning for Conservation Lands. Presentation at the Spring 1997 Meeting of the Colorado Coalition of Land Trusts, Colorado Springs, CO; May 2, 1997.

Education and Skills for The Nature Conservancy. Presentation at Natural Resources Days Seminar, Colorado State University, Ft. Collins, CO; April 8, 1997

Biodiversity. Presentation at annual meeting of Colorado Section of Society for Range Management and Soil and Water Conservation Society; Colorado Springs, CO; Nov. 14, 1996.

Conservation Easements and How They Work. Presentation at the Land Use Planning Land Trust In-Service Training. Colorado State University, Ft. Collins, CO, March 14, 1996.

The High Creek Fen Preserve: A Natural Legacy for Colorado. Presentation to the Colorado Federation of Garden Clubs, Denver, CO, February 27, 1996.

Plant Community Dynamics in a Rare Mountain Meadow Community. Poster presented at international stewardship conference of The Nature Conservancy, Savannah, GA, January 31-February 2, 1996.

The Nature Conservancy. Poster presented at the annual meeting of the Society for Range Management, Colorado Springs, CO, February 15, 1994.

The Nature Conservancy's program in the San Miguel basin. Panel discussion at the symposium "Ecosystem management: beyond the rhetoric", Ft. Collins, CO, November 1993.

The Nature Conservancy. Panel discussion at the Colorado Cattlemen's Association, Young Cattlemen's Leadership Conference. Denver, CO, March 4, 1993.

The Nature Conservancy and agriculture. Presentation at the annual meeting of the Colorado Farm Bureau, Denver, CO, March 4, 1993.

What do I want from the land? Panel discussion at the mid-winter of the Colorado Cattlemen's Association, Colorado Springs, CO, December 4, 1992.

Publications (aside from reports prepared for the above projects)

Carpenter, A. T. 2014. Review of *Colorado Flora Western Slope, 4th Edition – A Field Guide to the Vascular Plants.* Natural Areas Journal 34:254.

Carpenter, A. T. 2013. Review of *The Eastern San Juan Mountains: Their Geology, Ecology, and Human History.* Natural Areas Journal 33:112-113.

Carpenter, A. T. 2011. Review of *Letting Water Do the Work*. Natural Areas Journal 31:97-98.

Carpenter, A. T. 2010. Review of Carpenter, A. T. 2010. Review of *Ecological Restoration: Principles, Values, and Structure of an Emerging Profession*. Natural Areas Journal 31:

Carpenter, A. T. 2010. Review of *New Geographies of the American West*. Natural Areas Journal 30:106-107.

Carpenter, A. T. 2010. Review of Carpenter, A. T. 2010. Review of *Ecological Restoration: Principles, Values, and Structure of an Emerging Profession*. Natural Areas Journal 31:In Press.

Carpenter, A. T. 2010. Review of *New Geographies of the American West*. Natural Areas Journal 30:106-107.

Carpenter, A. T. 2009. Review of *Restoring Natural Capital*. Natural Areas Journal 29:318-319.

Carpenter, A. T. 2008. Review of *Corridor Ecology*. Natural Areas Journal 28:197-198.

Carpenter, A. T. 2007. Review of *Caring for Natural Rangelands*. Natural Areas Journal. In Press

Carpenter, A. T., T. A. Murray, and J. Buxbaum. 2002. Inventorying and mapping invasive plants. Natural Areas Journal. 22:163-165.

Brown, P. M, D. R. D'Amico, A. T. Carpenter, and D. Andrews. 2001. Restoration of montane ponderosa pine forests in the Colorado Front Range: a forest ecosystem management plan for the City of Boulder. Ecological Restoration 19:19-26.

Carpenter, A. T. 2000. Review of *Biology and Management of Noxious Rangeland Weeds*. Journal of Range Management 53:135-136.

Carpenter, A. T. 1999. Review of *Measuring and Monitoring Plant Populations*. Journal of Range Management 52:544.

Carpenter, A.T., J.C. Moore, E.F. Redente and J.C. Stark. 1990. Plant community dynamics in a semi-arid ecosystem in relation to nutrient addition following a major disturbance. Plant and Soil 126:91-99.

Carpenter, A.T. and M.F. Allen. 1988. Responses of Hedysarum boreale to mycorrhizas and Rhizobium: plant and soil nutrient changes. New Phytologist 109:125-132.

Carpenter, A.T. and N.E. West. 1988. Reproduction allocation in Artemisia tridentata ssp. vaseyana: effects of dispersion pattern, nitrogen and water. Bulletin of the Torrey Botanical Club 115:161-167.

Carpenter, A.T. and N.E. West. 1987. Indifference of mountain big sagebrush to supplemental water and nitrogen. Journal of Range Management 40:448-451.

Carpenter, A.T. and N.E. West. 1987. Validation of the reference unit method of phytomass estimation on shrubs and herbs. Vegetatio 72:75-80.

Neely, E.E. and A.T. Carpenter. 1986. Size, structure, and habitat characteristics of populations of Braya humilis var. humilis (Brassicaceae): an alpine disjunct from Colorado. Great Basin Naturalist 46:728-735.

Neely, E.E. and A.T. Carpenter. 1984. Noteworthy collections in Utah and Wyoming. Madrono 31:257.

Susan K. Sherrod, Ph.D.
Ecologist

ssherrod@biohabitats.com

SUMMARY

Specialized in ecosystem restoration, mine reclamation, T&E species conservation, wetland delineation, biological assessments, and landscape monitoring.

Familiar with alpine tundra, subalpine forest, grassland, wetland, Great Basin, and southwestern desert ecosystems.

Strong business, academic, research, and nonprofit experience and over two years as federal government scientist (TVA, USGS).

EDUCATION

Ph.D., Environmental, Population, and Organismic Biology, University of Colorado-Boulder, 1999.

B.S., Biological Sciences, Mathematics Minor, Colorado State University, Fort Collins, CO, 1992.

CERTIFICATIONS

Wetland Delineation, Wetland Training Institute, July 2013.

Functional Assessment of Colorado Wetlands (FACWet), Colorado Department of Transportation, June 2013.

Environmental Policy, CU-Boulder, 1997.

WORK HISTORY

Apr 2014–Present	Ecologist, Biohabitats, Inc.
2009–Present	Volunteer for the Institute for Environmental Solutions (since 2009) and Wildlands Restoration Volunteers (since 2012).
2002–2004, 2013	Instructor, Ecosystem Ecology and Advanced Ecology, and Co-Instructor, Environmental Management (with Austin Troy, Department of Urban Planning); University of Colorado-Boulder, University of Colorado-Denver, and University of Denver.
2001–2008	Associate, Bamberg Ecology, Denver, CO.
1999–2001	Postdoctoral Researcher, U.S. Geological Survey, Moab, UT (Jayne Belnap, Ph.D., supervisor), and Biogeochemistry Laboratory, Department of Biological Sciences, University of Denver (Buck Sanford, Ph.D., supervisor).
1997–1998	Coordinator, Niwot Ridge Long-Term Ecological Research (NSF) Grant Proposal, University of Colorado-Boulder (10 PIs). Secured $4.2 million for 1998-2004.
1993–1994	Environmental Scientist, Tennessee Valley Authority, Knoxville, TN.

RELEVANT PROJECT EXPERIENCE

Boulder Reservoir Environmental Inventory and Analysis, City of Boulder (Biohabitats subcontractor). Mapped 734 acres of plant communities and identified their dominant plant and noxious weed species. Subsequently provided quality rankings, analysis of recreation impacts, and management recommendations. June 2013–June 2014.

Conservation Easement Baseline Reports, Mountain Areas Land Trust (Biohabitats subcontractor). Surveyed and described properties using plant community designations of Colorado Natural Heritage Program, noted noxious weeds, and performed overall quality assessments for

- Teetering Rock Ranch (80 acres), Florissant, CO, June 2013
- West property (42.8 acres), Conifer, CO, Oct 2013

Wetland Delineation, City of Fort Collins North Shields Ponds Natural Area and Cache la Poudre River (Biohabitats subcontractor). This was the initial part of a restoration project to reconnect a 2000-foot reach of the Poudre with its original floodplain. May 2013.

Habitat Conservation Plans for Preble's Meadow Jumping Mouse and Environmental Assessments, Burt Automotive (Bamberg Ecological subcontractor). Wrote two HCPs and conducted EAs for Burt Automotive in both Castle Rock and Parker, CO, 2004-2006.

Westerly Creek Open Space Management Plan, Stapleton Redevelopment, Denver, CO. Wrote management plan for and monitored >60 acres and six disparate ecosystems (tallgrass and shortgrass prairie, cottonwood and wet meadow, and fescue and prairie sod) within residential/open space mixed development. Ecosystems are now self-sustaining. 2004-2005.

Restoration Monitor, Wildlands Restoration Volunteers. Monitored post-fire restoration areas at High Park, Fort Collins, CO. Used point-intercept method to compare two restoration treatments and a control, ten transects per treatment plot. July 2013. Also monitored restoration efforts at Chico Basin, Colorado Springs, CO, August 2013.

Field Crew Leader, Wildlands Restoration Volunteers. Led field crews at Braly Ponds restoration, Lyons (April 2012); Red Rocks trail restoration, Morrison (Oct 2012); Cherry Creek seeding, Denver (Oct 2012); Meadow Park flood cleanup, Lyons (Nov 2013).

Southern Ute Casino and Resort, Ignacio, CO. Assessed the progress of plant community establishment within landscaped areas and provided related recommendations for development. 2009.

Centerra Commercial Property, Loveland, CO. Devised and provided management recommendations to support native shortgrass prairie among retail parcels and conducted followup monitoring. 2007.

Pikes Peak Revegetation and Restoration, Teller and El Paso Counties, CO (Bamberg Ecological subcontractor). Wrote revegetation and restoration plan for severely disturbed roadways in alpine and subslpine ecosystems between 11,500 and 14,000 feet a.s.l.

Gold Mine Reclamation and Monitoring, three Mojave Desert mines (Bamberg Ecological subcontractor).

- Shumake Mine (Cactus Gold Mines Co.), Kern County, CA, 2003-2006. Supervised seed collection crews, collected seed, supervised aerial seeding with a crop duster, and provided subsequent monitoring.
- Castle Mountain Mine (Viceroy Gold Corp.), San Bernardino County, CA, 2003-2005. Collected seed and provided monitoring.
- Rand Mine (Glamis Rand Mining Co.), Randsburg, CA, 2004-2009. Monitoring only.

Clarke Farms Force Main Improvement Project, Parker, CO (Bamberg Ecological subcontractor). Wrote Biological Assessment in support of ESA §7 Consultation and a CWA §404 Permit for the installation of a 4420 linear feet of 16" PVC sanitary sewer force main line. Also performed followup monitoring. 2005-2006.

Tower Road Widening at First Creek and Green Valley Ranch Filing Nos. 62 & 63, Denver, CO (Bamberg Ecological subcontractor). Assisted with wetland delineation, sensitive species habitat assessment, a CWA §404 Individual Permit, as well as a CWA §404 Nationwide Permit for the Green Valley Ranch suburban development, including flood control and detention facilities, near Tower Road. 2005-2007.

Twenty Mile Outfall, Parker, CO (Bamberg Ecological subcontractor). Assisted with Biological Assessment for Preble's Meadow Jumping Mouse, acquisition of CWA §404 Nationwide Permit for a storm water drainage outfall into Cherry Creek in conjunction with road improvements, and followup monitoring. 2004-2006.

Westcreek Integrated Business and Housing Complex, Parke, CO (Bamberg Ecological subcontractor). Assisted with Biological Assessment for Preble's Meadow Jumping Mouse and acquisition of CWA §404 Nationwide Permit for a storm drainage system, and followup monitoring. 2004-2008.

Pesticide Research and Weed Factsheets, City of Boulder. Provided information on non-target effects of pyridine-, imidazolinone-, and sulfonylurea-based pesticides to inform a re-analysis of Boulder's pesiticide policies. Also wrote trifold factsheets on growth habits and non-chemical control of purple loosestrife, myrtle spurge, knotweed, and thistles for Boulder Police Department distribution to residents. March-May 2013.

Green Valley Ranch Golf Course, Denver, CO (Bamberg Ecological subcontractor). Assisted with acquisition of a CWA §404 Individual Permit and provided followup wetland mitigation monitoring. 2005-2006.

Ma'Laga Village and Golf Course, Ute Lake, NM (Bamberg Ecological subcontractor). Recommended phytoremediation methods for Ma'Laga Village and Golf Course Development. 2006.

Northcreek Farms, Thornton, CO (Bamberg Ecological subcontractor). Assisted with acquisition of CWA §404 Nationwide Permit for a wetland fill and sanitary sewer line crossing for a residential development and followup monitoring. 2005-2009.

Parker Gateway Center, Parker, CO (Bamberg Ecological subcontractor). Assisted with Phase I Environmental Assessment. 2004.

Wetlands Mitigation Monitoring, Alameda and Buckley Self Storage, Aurora, CO (Bamberg Ecological subcontractor). Sept 2007.

Centennial Corner Project, Centennial, CO (Bamberg Ecological subcontractor). Assisted in application for and acquisition of CWA §404 Individual Permit and provided subsequent monitoring. 2006-2007.

RESEARCH AND WRITING

Sherrod, S.K., T.R. Seastedt, M.D. Walker. 2005. The northern pocket gopher (*Thomomys talpoides*) as an organizer of alpine plant community structure, Niwot Ridge, CO. Arctic, Antarctic, and Alpine Research 37:585-590.

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Sherrod, S.K., J. Belnap, and M.E. Miller. 2002. Comparison of methods of nutrient measurement in calcareous soils: Ion-exchange resin bag, capsule, and membrane and conventional chemical extractions. Soil Science 167:1-10.

Sherrod, S.K. and T.R. Seastedt. 2001. Effects of the northern pocket gopher (*Thomomys talpoides*) on alpine ecosystem processes, Niwot Ridge, CO. Biogeochemistry 55:195-218.

Belnap, J., S.L. Phillips, and S.K. Sherrod. 2005. Soil biota can change after exotic plant invasion: does this affect ecosystem processes? Ecology 86:3007.

Belnap, J., S.K. Sherrod, and M.E. Miller. 2003. Effects of soil amendments on germination and emergence of downy brome (*Bromus tectorum*) and *Hilaria jamesii*. Weed Science 51:371-378.

Belnap, J. and S.K. Sherrod. 2009. Soil amendment effects on the exotic annual grass *Bromus tectorum* L. and facilitation of its growth by the native perennial grass *Hilaria jamesii* (Torr.) Benth. Plant Ecology 201:709.

Managing Editor, Structure and Function of an Alpine Ecosystem (W.D. Bowman and T.R. Seastedt, eds.), Oxford University Press, 2001.

Co-author, Towards a Bigger Picture: Environmental Protection and the Law in Colorado (primary author Federico Cheever, University of Denver Sturm College of Law), 2002-2003.

SCIENTIFIC REVIEW

Numerous manuscript reviews for *Ecology; Oecologia; Arctic, Antarctic, and Alpine Research; Journal of Ecology and the Natural Environment; Caribbean Journal of Science;* and *Agricultural Science Research Journal.*

PROFESSIONAL SOCIETY MEMBERSHIP (since year)

Ecological Society of America (1995)
Society for Conservation Biology (2007)
Colorado Native Plant Society (2008)
Society for Ecological Restoration (2011)
Rocky Mountain Association of Environmental Professionals (2012)
Colorado Riparian Association (2014)
Society of Wetland Scientists (2014)

PRESENTATIONS

Biogeochemical control of cheatgrass (*Bromus tectorum*) germination, emergence, and growth. 2001 Ecological Society of America annual meeting, Madison, WI. Coauthors J. Belnap and M.E. Miller.

The role of the northern pocket gopher (*Thomomys talpoides*) in the alpine tundra, Niwot Ridge, Colorado. Invited Seminar, Department of Biology, University of Denver, October 2, 2000.

The northern pocket gopher (*Thomomys talpoides*) as an organizer of alpine ecosystem and plant community structure. 2000 Ecological Society of America annual meeting, Snowbird, UT. Coauthor T.R. Seastedt.

Long-Term Ecological Research at Niwot Ridge, CO, and the Role of the Northern Pocket Gopher. Invited International Conference, U.S.-Japan Workshop on LTER, June 17, 1999, Tomakomai, Hokkaido.

The role of the northern pocket gopher (*Thomomys talpoides*) in the alpine tundra, Niwot Ridge, Colorado. Seminar, Department of Environmental, Population, and Organismic Biology, University of Colorado-Boulder, May 1999.

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Effects of the Northern pocket gopher (*Thomomys talpoides*) on the alpine soils of Niwot Ridge, CO. 1997 Ecological Society of America annual meeting, Albuquerque, NM. Coauthor T.R. Seastedt.

POSTERS

Sherrod, S.K. and T.R. Seastedt. Chemical responses of alpine soils to disturbances by the Northern pocket gopher (*Thomomys talpoides*) at Niwot Ridge, Colorado. 1997 Soil Ecology Society Conference, Manhattan, KS.

Seastedt, T.R., S.J. Pauker, J.M. Laboe, and S.K. Sherrod. Changes in soil characteristics associated with tree island movement in alpine tundra. 1996 Ecological Society of America meeting, Providence, RI.