Attachment A

CSR Natural Resources Consulting, Inc.

OWEB Juniper Treatment Effectiveness Monitoring Final Report

This report is submitted to the Oregon Watershed Enhancement Board (OWEB) as a summary of findings made during the summer of 2005 on seven OWEB-funded western juniper treatment projects in the John Day/Clarno Ecoregion of central Oregon. The purpose of this effort is to determine the effectiveness of the OWEB Juniper Treatment Program. The sites reviewed are in private ownership and are located in the Deschutes and John Day River Basins. Since all treatments had been applied during 2001 through 2003, the sites visited had at least two years of response time before being monitored. This study was funded under OWEB Contract No. 204-937, as amended and was conducted by CSR Natural Resources Consulting, Inc. of Vancouver, Washington.

The report summarizes the observations and measurements made at each project location and are presented in a format similar to that contained in the individual project monitoring summaries. Included in the report are a description of methodology employed in monitoring, a set of recommendations intended to support OWEB grant program effectiveness, technical quality, the success of future projects and the sound investment of public funds.

I want to thank Glen Hudspeth of the Crook County Soil and Water Conservation District and Sue Greer of the Wheeler County Soil and Water Conservation District for their assistance in arranging site visits, in helping to locate the project sites and providing additional information that added valuable background and detail to this report. Thank you, Pete Jameson, OWEB grantee, for your contagious enthusiasm for OWEB Program and this monitoring project.

I want to recognize and thank John and Lynn Breese of Prineville for their kind hospitality during the 2005 field season. Their support helped keep costs down which meant more projects monitored and resulted in a broader array of information for this report.

Submitted in satisfaction of OWEB Contract No. 204-937, as amended,

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Introduction

In the late 1990's the Oregon Watershed Enhancement Board (OWEB) began funding grants to promote watershed restoration in the uplands of central and eastern Oregon. Among the projects OWEB began to fund was the control of western juniper, a species native to Oregon in post-glacial times. Miller, in his recently published compendium on western juniper: The Biology, Ecology and Management of Western Juniper, states that western juniper woodlands occupy about 2.2 million acres in Oregon and is increasing in extent at about 3 percent per year, its greatest rate of expansion in the past 130 years - the period of European settlement and occupation (Miller, et al., 2005). He further states that this expansion is the result of a number of factors working in combination: a period of wet, mild climatic conditions in the late 1800's and early 1900's coinciding with the post-settlement period; the introduction of, and season-long grazing by, large numbers of domestic livestock beginning in the late 1800's that reduced fine fuels and reduced the frequency and effect of naturally occurring fires, exacerbated by increasingly sophisticated fire suppression, and the increase in industrial carbon dioxide as identified by significant increases in annual sapwood growth since the 1950's when compared with earlier periods. Additionally, the cessation of aboriginal burning is considered to have had significant influence in the expansion of western juniper (Dr. Lee Eddleman, OSU Rangeland Ecologist, personal communication. 2003). Eddleman also suggested that the primary mechanisms of seed dispersal supporting the expansion are birds that ingest the seed and disperse it through the environment and the downslope transport of seed by overland flow and concentrated flow in ephemeral gullies and washes – all common in juniper dominated sites.

An interest in controlling juniper has been held by rangeland managers and landowners for many decades. Initially, the control of juniper was a way to improve forage production for grazing livestock by reclaiming lands encroached upon and dominated by juniper. But in recent years, with the growing appreciation of ecosystem function and the understanding of the importance of the hydrologic function as a major driver in functioning systems, the negative effects of in Oregon and the West is better appreciated.

Juniper, once established in the rangeland plant communities is a shrewd competitor for moisture, for space, sunlight and nutrients. Its affects are not only negative to native plant community integrity and the hydrologic function of arid and semi-arid watersheds, but also detrimental to valuable wildlife habitat, and the productive capabilities of private lands.

Juniper belongs in the landscape but, being intolerant of fire, is most suited to places in the landscape of low fire frequency or that do not produce ground fuels capable of carrying fire or producing flame lengths that lift fire into the tree canopy. These locations are readily identified as shallow or unproductive soils, rock outcrops, and rim rock.

Juniper control should not aim at juniper eradication but to back juniper out of the deep, productive soils it has encroached upon with the reduction in normal fire frequency and the other factors promoting its spread.

Project Methodology and Results

This monitoring effort was undertaken to determine the effectiveness of OWEB-funded juniper treatments in restoring hydrologic function to juniper dominated lands in Oregon as well as project effects on other important aspects of ecological function including soil stability and condition, biotic integrity, plant community composition and production.

Methodology

Projects to be monitored were selected from a list of about 17 projects provided by OWEB staff. Approximately 12 of the treatments involved felling juniper with chainsaws without any further treatment; three projects were accomplished with larger equipment (dozer, track hoe and brush beater) and incorporated seeding, and two projects included felling with chainsaws and dozing into piles for burning. From these three groups, seven projects were selected that would provide the opportunity to observe the effects these treatment categories. The sites selected for review are located within watersheds associated with anadromous fisheries in the Columbia Basin system in the Deschutes and John Day River Basins.

Sites were located on the ground with the assistance of Soil and Water Conservation District representatives (Glen Hudspeth of Crook SWCD and Sue Greer of Wheeler SWCD) who had first hand knowledge of the projects in their respective districts, or by the landowners (the grant applicants) themselves.

During a site visit, the treated and adjacent un-treated areas were walked and general observations made. Typifying areas within both the treated and un-treated sites were chosen for more detailed analysis. Soil pits were dug in each representative area to determine soil depth, surface and sub-surface soil texture and other distinguishing soil characteristics or limitations, if any. Adjacent, un-treated sites were considered for sampling only when their soil, steepness of slope and slope orientation were the same as those on the treatment area. Two projects lacked these un-treated comparison areas.

Vegetation sampling was done using the pace transect method described by Herrick (Herrick, et al., 2005). Photographs of the transect areas in both the treated and untreated areas were taken and included an identifying marker containing the project number and date of the visit.

A rangeland health assessment was conducted for both the treated site and un-treated comparison area. The assessment was based on the method described in *Interpreting Indicators of Rangeland Health* (Pellant, et al., 2000) which resulted in determinations of ecosystem function relating to soil stability, hydrologic function and biological integrity for each site. Individual project reports containing the data and information recorded at the site, along with a summary discussion of observed and measured effects, landowner comments and resource management implications were then drafted.

Summary of Effects

The following summarizes the general changes observed on a project-wide basis with significant exceptions noted. For more specific details regarding project effects at the various project sites, please refer to the individual project reports:

Changes in Plant Community Composition

Of all the changes observed in this monitoring project, change in plant community composition is the most obvious but, nonetheless, rich with information. While the reduction in, or removal of the juniper canopy was common to all sites, the responses of the previously existing understory vegetation or subsequent seedings varied considerably.

Four projects (#'s: 18-02-014, 18-02-013, 201-253 and 99-604) included tree removal only and relied on the existing understory vegetation for site reoccupation. In three of these cases, there had been a sufficient amount of native grasses, forbs and shrubs in the juniper understory to support their full reoccupation of the site. However, one project (# 99-604) had an apparently (no comparison area available) very sparse stand of native perennial plants in the pre-treatment understory. In this case the treatment exposed the site to occupation by annual grasses and forbs with only scattered remnants of desirable native grasses, forbs and shrubs found on the site.

Three projects (#'s: 18-02-009, 18-04-003 and 200-166) were seeded with grass and forb mixtures, two of which were seeded with a seed drill following tree removal - both seedings are successfully established. Project # 200-166 was broadcast seeded before tree removal but it appears that the released, existing native grasses forbs and shrubs may have been able to re-occupy the site. This left some question regarding the need for the seeding at this location. There appeared to be an adequate stand of live native perennial grasses in the adjoining un-treated area to indicate an adequate stand already existed in the treated area.

Changes to Soil Surface Conditions

There were two situations in which changes to soil surface conditions were most apparent: where downed trees were pushed into piles with a dozer or the site was seeded with a drill seeder after felling and piling. Where trees were dozed into piles, plant litter and soil surface organic matter was removed or displaced, creating bare soil and an erodible condition in the short term and, in one case (Project 99-604); the un-seeded site was open to invasion by non-native annual grasses and forbs (weeds).

Drilled seedings continue to show furrows or drill rows which contribute to the surface roughness aiding in detention of overland flow and supporting infiltration and subsequent soil moisture storage.

Sites on which trees were felled and left in place showed no surface disturbance and in all cases the release of understory vegetation, accumulating plant litter (including downed trees) and biological crusts were protecting the soil surface from raindrop impact, detaining overland flow, promoting infiltration and aiding in soil moisture retention. Sheet erosion, which was common in the un-treated comparison area, was not in evidence on these treatment areas. Active rills and gullies were common in the un-treated areas, whereas in the treated areas no rills were observed and gullies were healing as native perennial plants were re-establishing and sediment was being trapped by the recovering vegetation.

A brush-beater was used to control the young (less than 40 years old), small diameter trees at the site of project # 18-04-003. Prior to treatment, the site had been dominated by mountain big sagebrush. Juniper was subordinate in the plant community at the time of treatment - Phase 1 of Miller's woodland succession (Miller, et al. 2005). Both species were controlled by brush beating and the resulting slash and plant litter effectively dissipate raindrop impact, detain overland flow, promote infiltration and, by shading the soil surface, aid in retaining soil moisture for the seeding that was done following treatment.

Changes to Site Hydrology

All grant applications addressed the restoration of hydrologic function as a major project objective. In all cases, plant responses following release or seeding appear to provide effective soil surface protection against raindrop impact. In addition, accumulating plant litter is detaining overland flow, promoting infiltration and aiding in soil moisture retention by shading and insulating the soil surface. Often overlooked is the effect of removing the intercepting canopy cover of juniper. According to Dr. John Buckhouse, OSU Rangeland Hydrologist, a juniper canopy cover of 25 percent on a site can intercept and thereby reduce the amount of moisture reaching the soil surface and understory vegetation layers by 25 percent (Personal comm. 2004), a significant amount in the 12 to 14 inch annual precipitation zone where most western juniper occurs. The intercepted moisture is lost back to the atmosphere by evaporation or sublimation, or through stemflow, which is directed to the base of the individual tree for its sole benefit. Most treatment locations are estimated to have supported juniper canopy covers in the range of 15 to 30 percent prior to treatment.

With one exception (Project # 99-604), all indicators: plant productivity, plant density, plant litter accumulation, biological crusts, minimal amounts of bare ground and the lack of evidence of overland flow, sheet, rill and gully erosion at all project locations, point to the recovery of infiltration rates expected in functioning systems. In the case of this exception, the site was re-occupied by annuals grasses and forbs that lack long-term dependability in soil surface protection and hydrologic function.

Western juniper is, according to Dr. Lee Eddleman, OSU Rangeland Ecologist, capable of taking up and transpiring soil moisture during every month of the year (Personal comm., 2003). The return to winter-dormant plant communities that occurred following the treatments has improved the opportunity for the soil profile to store all (keep in mind the potential for additional moisture made available by reducing interception), or most, of the precipitation received on site during late fall, winter and early spring – which amounts to 60 to 70 percent of annual precipitation (USDA-SCS, 1990). It becomes axiomatic that, following these treatments and with the right conditions of soil texture and soil depth and sub-surface geology, there is the enhanced probability that surplus soil moisture contributes to groundwater recharge (e.g., in moderately deep soils over fractured basalt) or that surplus moisture may move safely downslope as lateral flow (sub-surface flow, parallel to the slope) to supply flow to seeps, springs and riparian areas and, eventually, may promote long duration flows of cool, quality water to streams and other water bodies. This is in contrast to the situation in which juniper, in the codominant and dominant stages of woodland succession (Miller, et al., 2005), is capable of consuming the available soil moisture stored in the soil during any season of the year.

The exception, Project # 99-604, is dominated by annual grasses and forbs which can be ephemeral by nature, with unpredictable annual productivity, and may not support long- term infiltration and soil surface protection. Fire will remove all accumulated litter and plant stems on annual sites, leaving the soil prone to heavy overland flow, severe erosion and sediment yield.

At project # 201-253, “young” (probably 20 – 60 year old) trees were removed while mature trees were left standing. It is expected that a short-term improvement in hydrologic conditions may have been served, but in the long-term there appears to be enough live mature trees remaining to fully occupy the site and have the competitive advantage in acquiring the available moisture and nutrients at the site. According to Dr. John Buckhouse, eight to nine mature, healthy trees per acre, because of the extensive root systems are capable of fully occupying a site and commandeering its resources (Personal comm., 2006).

It is interesting to note that at one project location, a stock pond was installed in an area of heavy juniper concentration. Before treatment, the pond filled every year with surface runoff from the bare soils in the juniper stand immediately upslope. Following the removal of juniper, the stock pond is dry year-round - the result of improved infiltration and deep moisture percolation, it is believed.

Changes in Spring, Seep, and Stream Flow

There has been limited research on the effects of juniper reduction on rangeland hydrology. Specific questions regarding changes in soil-plant-moisture relationships, groundwater recharge and changes to spring, seep and stream flow have not been well addressed by the research community. However, the anecdotal record is replete and growing with observations and evidence of the positive hydrologic effects of returning juniper to its rightful place in the landscape – relieving it of the awesome responsibility of dominance.

At two project locations, grant recipients credit juniper removal with restoring spring flows and in one case, reviving a wet meadow in areas downslope of the treatments. At project #18-02-009, a spring, formerly a seep, below the 240 acre juniper treatment now yields 20 gallons per minute year-round. A similar situation was reported, and observed on the same property in which an area of damp soil became a spring with a 20 gallon per minute year-round flow following the clearing of 40 acres of juniper immediately above the site. The landowner built a pond at the spring discharge point and now raises rainbow trout at the site of the spring.

At project # 18-02-013, the recovery of flow of several springs and the revival of a two to five acre meadow is attributed to upslope juniper control.

At the remaining project locations, no observations were reported nor are there records of past or present flows that would indicate change.

Changes in Wildlife Habitat

Pre-treatment conditions at all locations provided thermal and escape cover to deer and elk and habitat for several species of tree dwelling birds, however this form of cover and habitat is not believed to be a limiting factor for any of these wildlife species in this region of the state. The treatments have restored critical habitat elements including forage, water, important edge-effect and a mosaic of habitats for a broad complex of mammalian, avian and amphibian species. Un-treated areas adjacent to the projects continue to retain their limited habitat values and provide habitat connectivity throughout the landscape.

Changes in Forage Production

Of the seven projects monitored, all but one (Project # 201-253) are used for livestock grazing. Two projects (#'s 18-02-009 and 18-04-03) were seeded with a drill. On both seeded sites, forage production in the pre-treatment condition was so low (about 150 pounds per acre or less) that livestock were not grazed in the areas. Post-treatment forage production is estimated to be in the range of 1,000 to 1,200 pounds per acre (lbs/ac.), or about 1.0 to 1.5 acres per animal unit month (AUM).

Project # 200-166 was broadcast seeded before tree removal. Conditions in the adjacent comparison area indicate that seeding may not have been needed. According to Dr. Lee Eddleman, OSU Rangeland Ecologist, 2.5 plants (of desired native grasses) per square meter (or 2 plants per 10 sq. ft in Miller) indicate an adequate source of plant material and seed for the re-occupation of treated sites (Eddleman. Pers. comm. 2003 and Miller, et al., 2005).

The design of project #'s 18-02-014, 18-02-013 and 99-604 counted on the release of, and re-occupation by, the existing native understory vegetation. In both former instances, forage production is estimated to have doubled or tripled following release: an estimated increase of from 500 pounds per acre to1, 000 lbs/ac., and from an estimated 300 lbs/ac. to 900 lbs/ac, respectively. Results differed on project 99-604 in that the site probably supported a less than optimum density of desirable species and was over-taken by annual grasses and forbs of limited seasonal value and with high variable and unpredictable annual production.

Results of Rangeland Health Assessment

Rangeland health was assessed at each site, in both the un-treated comparison area and in the treatment area. The assessment method uses a qualitative approach in determining the degree of function for three essential elements: soil stability, hydrologic function and biotic integrity (Pellant. 2000). Ratings descriptors used in this assessment are: functioning, functioning-at-risk and non-functioning. A “functioning” rating implies that the indicators for a specific element being assessed are at, or very near, the ecological potential expected for the site. A rating of “functioning-at-risk” means that evidence inferred from the observation of indicators suggests that the site departs to a moderate degree from its potential. Within this rating is the recognition of trend toward or away from site potential. Finally, a “non-functioning” rating means extreme or severe departure from potential.

Soil Stability

With few exceptions, soil stability in all pre-treatment or comparison areas rated as non-functioning with strong evidence of sheet, rill or gully erosion occurring in the juniper understory. The first exception was found on a flat slope with little potential for water erosion, with a stabilizing biological crust to protect against raindrop impact, and a dense stand of sagebrush to protect the soil from wind erosion. The second exception showed herbaceous vegetation in the inter-spaces between trees adequate of maintaining soil stability. In all cases but one, function was restored in the treated areas by increased plant cover and accumulating plant litter. Rills and evidence of sheet erosion were not observed and gullies were healed or healing. The exception is a site that was occupied by annual grasses and forbs which may, in the long term, not provide the mechanisms for soil protection offered by perennial vegetation. It was rated as functioning-at-risk with no apparent trend.

Hydrologic Function

Hydrologic function was rated as non-functioning at each pre-treatment comparison area. Canopy interception and low infiltration rates were the prevalent issues on these sites. Excessive soil moisture transpiration by juniper was also considered in the assessment - a common feature on most pre-treatment areas. Following treatment, all but two sites were determined to be fully functioning. Those were, once again the site dominated by annuals which was rated as functioning-at-risk with no apparent trend. The other exception, rated as functioning-at-risk, was more of a juniper thinning project than control. It is anticipated that the excessive transpiration of soil moisture will increase in the near and mid-term.

Biotic Integrity

All pre-treatment or comparison areas rated as non-functioning in biotic integrity. Where potential vegetation would have included a wide array of perennial native grasses, perennial and annual native forbs and shrubs, these areas were dominated by shallow-rooted perennial grasses or very sparse stands of deep rooted grasses with some forbs and, in many cases, the skeletal remains of shrubs – victims of competition. In other words, the diversity of functional plant groups (e.g., deep rooted perennial grasses, mid- and shallow rooted perennial grasses, leguminous forbs, etc.) was sparse, or poorly represented – the crux issue in biotic integrity. Biotic recovery is slow. The physical parts of the system need to recover before the vegetation can respond. In all but one of the treatment areas ratings were, for the most part functioning-at-risk because limited but returning species diversity. One site is considered to be fully functioning and the last, the annual grass and forbs dominated site, is rated as non-functioning.

Recommendations

The site visits to the seven treatment areas illustrated the values accrued to the land and its ecological function; to wildlife, and to the economic sustainability of the landowner. There was not a landowner interviewed who was not ecstatic with the outcome of their project and proud to show its results. These landowners we all very positive about OWEB's role in promoting this activity and hoped the program flourished throughout the region.

Aside from the positive outcomes on the land and in the minds of the program participants, there are lessons to be learned from this review. If applied to future projects, these lessons could help improve the likelihood of greater project success at higher efficiencies of cost.

Among the projects reviewed, there were those whose design (including site selection), implementation and follow-up were flawless. There were projects, on the other hand, where a pre-treatment inventory and the application of the information derived therein, would perhaps have avoided higher than necessary costs or would have helped insure a more positive response from the treatment.

The findings and recommendations of the interim project report submitted in August, 2005 are incorporated herein by reference and further recommendations intended to improve program effectiveness follow: Recommendation 1 Conduct a Juniper Management workshop which would include site visits for appropriate OWEB Regional Representatives and staff along with selected SWCD and Watershed Council staff. A workshop of this nature would allow those personnel most directly related to the grant application process to observe and to discuss project results as influenced by site selection, pre-treatment conditions, treatment methods and follow-up treatments related to the degree of projects success. Since these are the people working most directly with grant applicants, they are in the ideal position of influencing project design and implementation within OWEB standards.

Recommendation 2 Draft and distribute guidance for use by OWEB, SWCD and Watershed Council staff and landowners regarding the various elements to be considered and employed in the design, implementation and management of juniper treatments. The document might include discussions of: site selection, determination of project need and priority, pre-treatment assessment and inventory and their application to the selection of treatment methods and post-treatment management.

Recommendation 3 Establish a protocol for the pre-treatment collection of soil, plant and hydrologic information that would serve two purposes: 1) to be used as the basis of treatment design (e.g., the need for seeding, the disposal of slash, etc.) and, 2) to provide base data for future monitoring of changes in tree density and canopy cover, plant composition, overland flow and soil erosion and the presence and flow of springs and seeps. The use of such a protocol would help to insure that the essential elements of a project are considered in its design and that un-needed treatments are avoided. Such a protocol would have provided information that was either unavailable or indirectly available (through the examination of adjacent un-treated sites) to establish comparisons in the 2005 review.

Recommendation 4 Continue the current monitoring effort and expand the process to include other regions of the state beyond the anadromous fisheries basins. Support an effectiveness monitoring program in eastern and south central Oregon as those areas are also in need of ecological and especially, hydrologic recovery and rehabilitation – there are more lessons to be learned that will continually improve the effectiveness of the OWEB program.

Recommendation 5 Promote and support research in the rehabilitation (and maintenance) of watershed uplands in the juniper dominated regions of Oregon as OWEB has with the DeBoot Doctoral Paired-Watershed Research Project in central Oregon.

Conclusion

Uplands make up about 98 percent of the land area of most watersheds. It follows that uplands are in the position to receive and process that proportion of the precipitation falling in the watershed. When functioning to their potential, uplands effectively capture that moisture at the soil surface, store it in the soil profile for plant use and other forms of biological activity, and safely release any surplus moisture to recharge groundwater or support the flow of seeps, springs and streams. Followed to its logical conclusion, a functioning watershed can support vegetation and plant communities, habitats and economies according to its productive potential. Inasmuch as its potential provides, functioning uplands can contribute significantly to the quality and quantity of long duration seep, spring and stream flows.

In contrast, upland hydrologic dysfunction, or the inability of upland soils to capture, store, and/or safely release moisture, produces negative effects downslope and down stream. This contrast was evident in most of the treatment areas visited in this project where comparison areas were identified. While the identification of some effects (e.g., changes to site hydrology, etc.) is qualitative, they are based in concepts of climatology, soil science, soil-plant-water relationships and the dynamics of rangeland plant communities and rangeland ecology. Other identifiable effects such as changes in plant community composition and changes in forage production are readily quantified.

In the opinion of this observer, the project visited and the information gathered from conversations with landowners and from personal observation and measurement the value and effectiveness of the OWEB Juniper Treatment is clear.
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