WESTWATER II FIRE: CQC0

MONITORING SUMMARY and FUNDING REQUEST

Fiscal Year of Fire	2006
Fire Containment Date	6/16/06
Fire Size	2,847
BLM Acres Burned	2,793
ES Plan Total Planned Costs	$209,000 *(Actual $248,177)*
ES Acres Treated	1,128
BAR Plan Total Planned Costs	N/A
BAR Acres Treated	N/A
State/Field Office	Utah – Moab Field Office
Contact Person	Brian Keating
Area Code/Phone Number	(435)259-2194

1) MONITORING SUMMARY (End of 3rd year)

Emergency Stabilization Treatments

Treatment 1:

ES Treatment		Unit	# Units	Cost/Unit	Total Cost	Degree of Success
S-16	Monitoring	*acres*	1,128	$2.65	$1,600	Fully Successful
Objective: Vegetative monitoring of the treatment area to determine the success and/or failure of the stabilization treatments. Monitoring objectives for FY2009 included monitoring of the germination and establishment of both seeded and invasive species within macroplots established in FY2007. In addition, a third year final monitoring report will be completed and submitted as required by ES&R policy.						
Implementation Monitoring: Monitoring activities include reading and data collection of existing monitoring plots throughout the treatment area.						
Effectiveness Monitoring: Monitoring will include the interpretation of collected data to determine the establishment rate of seeded grasses as well as the amount (cover and frequency) of invasive species to the project area.						

Monitoring Results**:**

For fiscal year 2009, cover and frequency data and repeat photography were collected on the five macroplots that were established in FY2007. Data analysis has been completed and observations indicate that seeded species germination and establishment was moderately successful while cheatgrass establishment is relatively high. Functional group cover and frequency data for the five macroplots are shown below (fig. 1 and 2). The "preferred" functional groups include both seeded and non-weedy naturally occurring plants but may not have significant wildlife value. Preferred grasses and forbs had mixed results but overall were marginally successful at meeting objective thresholds for frequency and cover. With both cover and frequency, the seeded grasses were also marginally successful showing clear success in only one soil type. Seeded forbs and shrubs have shown limited response but this may be a result of shrubs needing more than three years to establish. Cheatgrass cover exceeded the threshold for cover and the management objective was not met. However, cheatgrass cover was 19% higher in the control plot which indicates that the seeding did have a positive ecological and statistical effect on reducing cheatgrass cover by establishing seeded species.

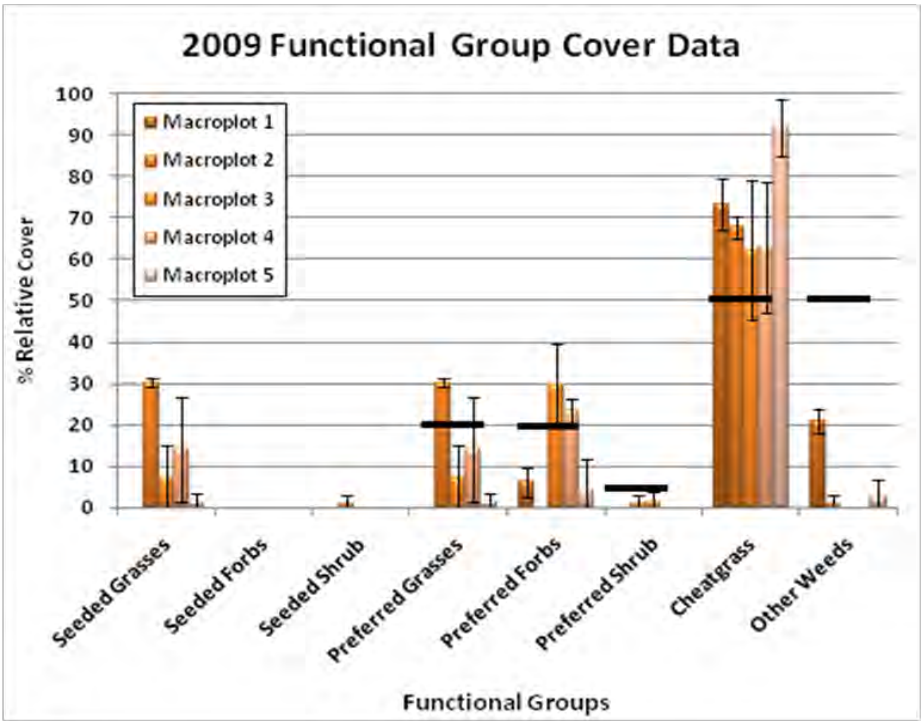

Figure 1. Relative Percent Cover of Functional Groups in 2009. Black lines show objective thresholds and error bars show 90% confidence interval.

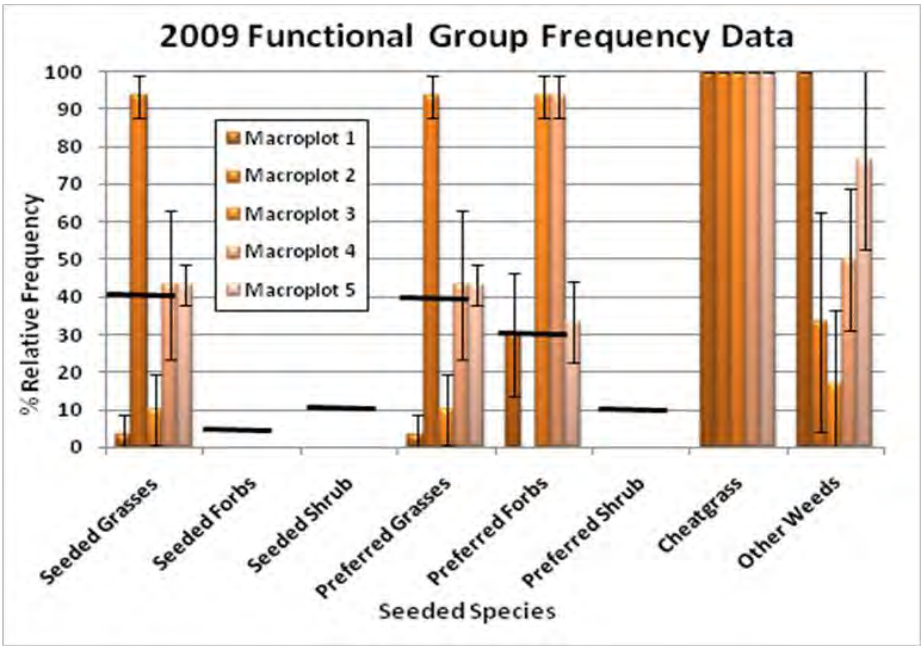

Figure 2. Relative Frequency of Functional Groups in 2009. Black lines show objective thresholds and error bars show 90% confidence interval.

2) END OF THIRD-YEAR CLOSEOUT SUMMARY

The Westwater II fire consumed 2,743 acres of BLM managed lands in Grand County, Utah approximately 2 miles south of the I-70 corridor and 2 miles west of the Utah/Colorado state line in June, 2006. The affected area falls within the BLM Moab Field Office and is located in an area dominated by a mix of native grasses and forbs with a cheatgrass component. Due to the proximity of the fire to the I-70 corridor, high wind erosion probabilities, wildlife habitat and concerns with noxious weeds, an interdisciplinary team determined that post-fire rehab was warranted. The fire rehabilitation plan identified 1,128 acres to be drill seeded with a mix of native and non-native grasses, forbs and shrubs. Costs associated with the Westwater II Fire Rehabilitation Project over the three year life span of the project total approximately $248,177 ($13,500 for initial ID team and final plans; $25,921 for archeology survey; $114,382 for seed/processing; $56,400 for drill seeding contract; $5,128 for vehicles and drill costs; $11,000 for monitoring/data analysis; $7,846 for supplies and materials and $14,000 for labor).

A monitoring plan was developed for the project with the goal of determining the success of the drill seeding treatment. Five macroplots were established (four in the treated area and one as a control plot in a non-treatment area) utilizing 100' linear transects. Frequency was measured through a nested frequency frame and cover was measured through the use of line-point intercept methodology. In addition, photopoints were established at each macroplot and data was collect at each site pre-treatment, post-treatment and three growing seasons following treatment. Monitoring results after three growing seasons indicate that the management objective for cover as it relates to overall vegetative recovery was marginally successful but did not meet any of the objectives for treatment effectiveness. The management objective for frequency as it relates to vegetative recovery was marginally successful for preferred grasses and forbs but completely failed for shrubs while treatment effectiveness was marginally successful only for seeded grasses. Other conclusions reached as a result of monitoring data collected indicate that variations in soils played an important role in the establishment of seeded species. Lastly, monitoring result indicate that the seeding treatment had a positive effect on reducing cheatgrass cover in the treated areas as compared to the control plot.

Lessons learned from the Westwater II Fire Rehabilitation Project include practical applications as they relate to treatment implementation as well as adjustments to how future monitoring objectives are defined and methodology applied. Overall, the project was marginally successful at meeting the defined objectives and provided valuable data that will be incorporated into future fire rehabilitation and vegetative restoration projects.

NOTE: See attachment for full monitoring summary report

3) REQUEST FOR NEXT YEAR'S FUNDING (2822)

Not Applicable.

4) REQUEST FOR FOLLOWING YEAR REHABILITION FUNDING (2881)

Itemized Listing of Actions, Purpose, and Costs:
Not Applicable.

Prepared by: Brian Keating
Date: November 9, 2009

United States Department of the Interior
Bureau of Land Management

January, 2009

Westwater II Emergency Stabilization and Rehabilitation Monitoring Report

T. 20 S., R. 24 E., Secs. 25
T. 20 S., R. 25.0 E., Secs. 15-16, 19-22, 27-32

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Executive Summary

The Westwater II fire consumed 2,743 acres of BLM managed lands in Grand County, Utah approximately 2 miles south of the I-70 corridor and 2 miles west of the Utah/Colorado state line in June, 2006. The affected area falls within the BLM Moab Field Office and is located in an area dominated by a mix of native grasses and forbs with a cheatgrass component. Due to the proximity of the fire to the I-70 corridor, high wind erosion probabilities, wildlife habitat and concerns with noxious weeds, an interdisciplinary team determined that post-fire rehab was warranted. The fire rehabilitation plan identified 1,128 acres to be drill seeded with a mix of native and non-native grasses, forbs and shrubs. Costs associated with the Westwater II Fire Rehabilitation Project over the three year life span of the project total approximately $248,177 ($13,500 for initial ID team and final plans; $25,921 for archeology survey; $114,382 for seed/processing; $56,400 for drill seeding contract; $5,128 for vehicles and drill costs; $11,000 for monitoring/data analysis; $7,846 for supplies and materials and $14,000 for labor).

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Lessons learned from the Westwater II Fire Rehabilitation Project include practical applications as they relate to treatment implementation as well as adjustments to how future monitoring objectives are defined and methodology applied. Overall, the project was marginally successful at meeting the defined objectives and provided valuable data that will be incorporated into future fire rehabilitation and vegetative restoration projects.

I. Introduction

The Bureau of Land Management, Moab Field Office, Moab Fire District, conducted stabilization activities on approximately 1,128 acres of public land near Westwater Canyon of the Colorado River, approximately ten miles northeast from the town of Cisco in Grand County, Utah. The stabilization consisted of mechanical drill seeding occurring in October and November of 2006.

Figure 2 - Westwater II Burn.

The lightning-caused Westwater II Fire spread over approximately 2,793 acres of public lands managed by the BLM including 655 acres of the Westwater Canyon Wilderness Study Area (WSA). The fire occurred in early June, 2006, and burned quickly through the area in a patchy mosaic (Fig. 1), especially in areas abundant with invasive species. In heavily burned areas, the fire left soils uncovered and subject to erosion from wind and water. Invasive plants that had moved into the area prior to the wildland fire include Cheatgrass (*Bromus tectorum*), Russian annual wheatgrass (*Eremopyrum tricetum*), halogeton (*Halogeton glomeratus*), redstem stork's bill (*Erodium cicutarium*), and Russian thistle (*Salsola kali*). Observations indicate that these invasive species are often more successful in germinating and establishing than native species after fire and may alter fire regimes. The alteration of fire regimes could lead to further ecosystem compromise as a result of more frequent, intense wildland fire if these invasives, particularly Cheatgrass, dominate the site. Without treatment, the area would be at risk of soil erosion, loss of productivity, and invasive species proliferation. Soil erosion in the burned area could result in sedimentation and eventual Colorado River water quality degradation as well as threatened and endangered habitat concerns along the Colorado River. Since the fire, the project area has been utilized as hunting grounds by raptors (Fig. 2) and nesting sites are apparently located nearby.

Figure 1. Golden Eagle near the Westwater II burn.

In analyzing treatment alternatives, an interdisciplinary team determined that seeding would be the most effective treatment to successfully prevent soil erosion, curtail the dominance and spread of invasive species, and improve habitat condition. The area was considered to be in Condition Class III (CC3), Fire Regime II prior to the wildland fire.

In CC3 areas, fire regimes and vegetation attributes have been substantially altered from their natural/historical range and the risk of losing key ecosystem components from wildland fire is high. The seeding treatment would be expected to stabilize soils, manage the spread of invasive species, and move the area toward Condition Class I (CC1), where fire regimes are within the natural/historical range and the risk of losing key ecosystem components is low. In subsequent years, as a result of this stabilization treatment, soils damaged by the Westwater II fire should become stable and support vegetative composition, structure, and patterns representative of a functional sagebrush/grassland ecosystem.

The stabilization plan includes the distribution of native and non-native seed in the more heavily burned areas using mechanical rangeland drill seeders. Seeding was implemented in the late fall to allow seed scarification prior to spring moisture for optimum germination. Approximately 1,009 acres throughout the 2,793 acre burn were planted with a native/non-native seed mix. Approximately 120 acres within the 655 acres burned in the WSA was seeded with native seed only. The Westwater Canyon WSA falls within the Little Hole sheep grazing allotment, and grazing has been restricted within the WSA as well as the remainder of the treatment area until the goals and objectives of the stabilization are met.

Drill seeding consists of furrowing soil at approximately 12-inch intervals with one- or two-inch deep furrows controlled by depth bands. Seeds are dropped into the furrows from a seed-dispersal tube, creating an ideal situation for germination and establishment. The advantages of planting native/non-native mixtures include improved control of undesirable weeds and an increased success rate in the establishment of desired species. Only native seed species would be utilized in the WSA to meet the non-impairment mandate, with a goal of enhancing the natural condition of the WSA. Mechanical drill seeding within the WSA burn area was staggered and irregular to avoid a straight-line plantation appearance. A cultural resource survey was performed to locate and designate areas where hand-seeding would occur and/or ground disturbance avoided.

Approximately one mile of existing range pasture fence was damaged or destroyed by the fire. The affected sections of fencing were rebuilt or repaired to ensure that livestock grazing would not affect the seeding treatment. Fence construction conformed to BLM Handbook specifications (H-1741).

Monitoring of treatment methods and effectiveness has occurred throughout the project area to establish success levels, determine potential treatment adjustments, and to document results for future ES&R treatment considerations. Monitoring results, weather patterns, or other factors could initiate a second stage of seeding treatment to provide optimum vegetative establishment.

II. Disturbance History

The Westwater II ESR project area has a fire recurrence interval of approximately 4 years. Fire history records show that two fires have overlapped the area within the last 20 years (Appendix A) while other fires are in close proximity. Several fires occurred in 2009 that are not yet shown in Appendix A. The Harley Fire (1986) overlaps the Bryson's eastern border while the Westwater II Fire (1994) overlaps approximately 85% of the Bryson Fire footprint.

The Little Hole sheep grazing allotment, in which this project is located, has been historically grazed by 1,770 sheep between Dec 7 and May 12.

III. Description of Ecological Model

SSURGO Map Unit 4 corresponds to the Begay-Sazi complex of soils and the Semidesert Sandy Loam range site (Hansen, 1989). The Semidesert Sandy Loam range site ground cover (vertical) generally consists of 35% grasses, 5% forbs, and 15% shrubs. Important grasses include indian ricegrass (*Achnytherum hymenoides*) and needleandthread (*Heterostipa comata*) with galleta (*Pleuraphis jamesii*), sand dropseed (*Sporobolus cryptandrus*) and bottlebrush squirreltail (*Sitanion hystrix*) present. According to the soil survey, common forbs inclue woolly milkvetch (*Astragalus purshii*) and scarlet globemallow (*Sphaeralcea coccinea*). However, repeat photography and quantitative data show smallflowered globemallow (*Sphaeralcea parviflora*) and rose heath (*Chaetopappa ericoides*) to be the dominant forbs. Common shrubs include fourwing saltbush (*Atriplex canescens*), Torrey jointfir (*Ephedra torreyana*), spiny hopsage (*Grayia spinosa*), winterfat (*Kraschenikovia lanata*), and Wyoming big sagebrush (*Artemisia tridentata wyomingensis*). Interestingly, of all these shrubs, only fourwing saltbush was observed albeit rarely. If this range site is overgrazed Indian ricegrass, winterfat, and fourwing saltbush decrease while galleta, broom snakeweed (*Gutierriziae sarothrae*) and low rabbitbrush increase (cite range site). When the range sit is burned, fourwing saltbush and Wyoming big sagebrush decrease while, galleta, broom snakeweed and low rabbitbrush increase (Hansen, 1989).

SSURGO Map Unit 42 corresponds to the Nakai-Redlands complex of soils and the Desert Sandy Loam range site. The Desert Sandy Loam range site ground cover (vertical) generally consists of 35% grasses, 10% forbs, and 20% shrubs. According the the soil survey, important grasses include Indian Ricegrass and Galleta with numerous other grasses represented in smaller quantities. Common forbs include Scarlet Globemallow and yellow milkvetch with many other forbs represented in smaller quantities. However, repeat photography and quantitative data show exotic forbs are abundant with Pale Evening Primrose (*Oenothera pallida*), Hoary tansyaster (*Machaerenthera canescens*), and smallflowered globemallow present. The survey suggests, common shrubs include fourwing saltbush (*Atriplex canescens*), shadscale, and winterfat. Although these shrubs are not present within the sampled area they can be seen in adjacent areas.

SSURGO Map Unit 54 corresponds to the Rock outcrop-Arches-Mido soil complex. The Arches soil is in the Semidesert Shallow Sandy Loam (Utah Juniper-Pinyon) range site while the Mido soil is in the Semidesert Sand (Fourwing Saltbush) range site. The Semidesert Shallow Sandy Loam range site description was not available. The Semidesert Sand range site ground cover (vertical) generally consists of 40% grasses, 5% forbs, and 20% shrubs. According to the soil survey, important grasses include Indian Ricegrass and needleandthread with numerous other grasses represented in smaller quantities. Common forbs include scarlet globemallow, wooly milkvetch, and pale Evening Primrose with many other forbs represented in smaller quantities. However, repeat photography and quantitative data show exotic forbs are most abundant with little recruitment of preferred native forbs. The survey suggests, common shrubs include fourwing saltbush, Wyoming big sagebrush, sand sagebrush (*Artemisia filifolia*).

IV. Treatment

The treatment areas (Appendix A) were seeded during the period of October 20 through November 15, 2006. The cover photo shows the methodology which included a tractor and two three-box drills pulled in tandem. The seed mix was separated into a WSA and a Non-WSA mix (Table 1 and 2). The primary difference is that the WSA mix only contained native species. Approximately 1,009 acres of the Westwater Non-WSA burn area was treated and 120 acres of the WSA burn area were treated in this manner. Drill seeding occurred within SSURGO Map Unit 4, 42, 54 (Hansen, 1989).

Table 1. Westwater II ES&R Non-WSA Seed Mix.

Common Name	Scientific Name	Lbs/Acre	# Viable Seeds/ft^2
Sand Dropseed	*Sporobolus cryptandrus*	0.94	4.06
Fourwing Saltbush	*Atriplex canescens*	0.35	38.98
Thickspike Wheatgrass	*Elymus lanceolatus (Critana)*	2.36	1.06
Indian Ricegrass	*Achnatherum hymenoides(Rimrock)*	1.42	4.19
Gooseberryleaf Globemallow	*Sphaeralcea grossularifolia*	2.59	10.40
Galleta Grass	*Pleuraphis jamesii*	0.12	1.12
Winterfat	*Krascheniko via lanata*	0.61	1.5
Russian Wildrye	*Psathrostachys juncea (Bozoisky)*	0.94	1.35
Siberian Wheatgrass	*Agropyron sibericum (P-27)*		
Blanketflower	*Gaillardia pulchella*	1.65	1.68
Quickguard	*Triticum spp.*	1.53	1.58
	Total	**11.49**	**36.25**

Table 2. Westwater II ES&R WSA Seed Mix

Common Name	Scientific Name	Lbs/Acre	# Viable Seeds/ft^2
Sand Dropseed	*Sporobolus cryptandrus*	0.94	4.06
Fourwing Saltbush	*Atriplex canescens*	0.35	38.98
Thickspike Wheatgrass	*Elymus lanceolatus (Critana)*	2.36	1.06
Indian Ricegrass	*Achnatherum hymenoides(Rimrock)*	1.42	4.19
Gooseberryleaf Globemallow	*Sphaeralcea grossularifolia*	2.59	10.40
Galleta Grass	*Pleuraphis jamesii*	0.12	1.12
Winterfat	*Kraschenikovia lanata*	0.61	1.5
	Total	**9.67**	**31.45**

V. Management Objectives

The following objectives were defined in the final Bryson Emergency Stabilization Plan. These first two years had defined density objectives and were not quantified because of the prevalence of rhizomatous species that could not be captured using density. This was a shortcoming of the monitoring plan. Year three objectives will be adopted for a determination of success.

A. Defined Objectives

Year 1 and 2 objectives will not include the seeded shrubs. Lessons from the Rattle Fire Complex ES&R Monitoring Project indicate that the first two years are dominated by grasses and forbs. Shrubs began to emerge after year two and therefore shrub objectives will not be defined until year three. Grass and forb germination is expected to be high in the first growing season but many of the seedlings will not establish and persist into the second and third growing season. The target threshold objectives are designed around this ecological trend.

Year 1 Objectives

Vegetation Objective:
Obtain average densities of seeded grasses of 10 plants/m^2 and seeded forbs of 5 plants/m^2 by the end of the first growing season following seeding within all soil types of the Westwater II ES&R treatment area.

Soil Stability Objective:
Soil stability test values from the burned sites will vary by only one stability class from the unburned sites within similar soil types of the Westwater II ES&R treatment area by the end of the first growing season.

Year 2 Objectives

Vegetation Objective:
Obtain average densities of seeded grasses of 5 plants/m^2 and seeded forbs of 3 plants/m^2 by the end of the second growing season following seeding within all soil types of the Westwater II ES&R treatment area.

Soil Stability Objective:
Soil stability test values from the burned sites are at the same stability class ranking as the unburned sites within similar soil types of the Westwater II ES&R treatment area by the end of the second growing season.

Year 3 Objectives

Year 3 objectives are combined with overall vegetation treatment monitoring objectives for the Westwater II fire rehabilitation project:

- **Management Cover Objective for Overall Vegetative Recovery**
  Obtain relative vegetative cover values for preferred lifeforms of 20% for grasses, 20% for forbs and 5% shrubs within the Westwater II burn site by the year 2010.

- **Management Frequency Objectives for Overall Vegetative Recovery**
  Obtain frequency values for preferred life forms (native species) of 40% for grasses, 30% for forbs, and 10% for shrubs by the year 2010 for the Westwater II burn area.

- **Management Cover Objective for Treatment Effectiveness**
  Limit the relative vegetative cover of annual weeds to 50% for cheatgrass (*Bromus tectorum*), Russian annual wheatgrass (*Eremopyrum tricetum*), halogeton (*Halogeton glomeratus),* redstem stork's Bill (*Erodium cicutarium)* and Russian thistle (*Salsola kali)* within the Westwater II burn area by the year 2010.

- **Management Frequency Objectives For Treatment Effectiveness**
  Obtain relative frequency values for the seeded species of 40% for perennial grasses, 5% for forbs, and 10% for woody species within the burn area by the year 2010.

- **Management Soil Stability Objective for Overall Recovery/Treatment Effectiveness**
  Soil stability test values from the burned sites are at the same stability class ranking as the unburned sites within similar soil types of the Westwater II ES&R treatment area by the end of the second growing season.

VI. Monitoring Design

A. Sampling Objective

- **Sampling Objective for Cover**
  I want to be 90% confident that the estimated cover values I obtain are within 20% of the estimated true value.

- **Sampling Objective for Frequency**
  I want to be 90% confident that the estimated frequency values that I obtain are within 20% of the estimated true value.

- **Sampling Objective for Density**
  I want to be 90% confident that the estimated density values that I obtain are within 20% of the estimated true value.

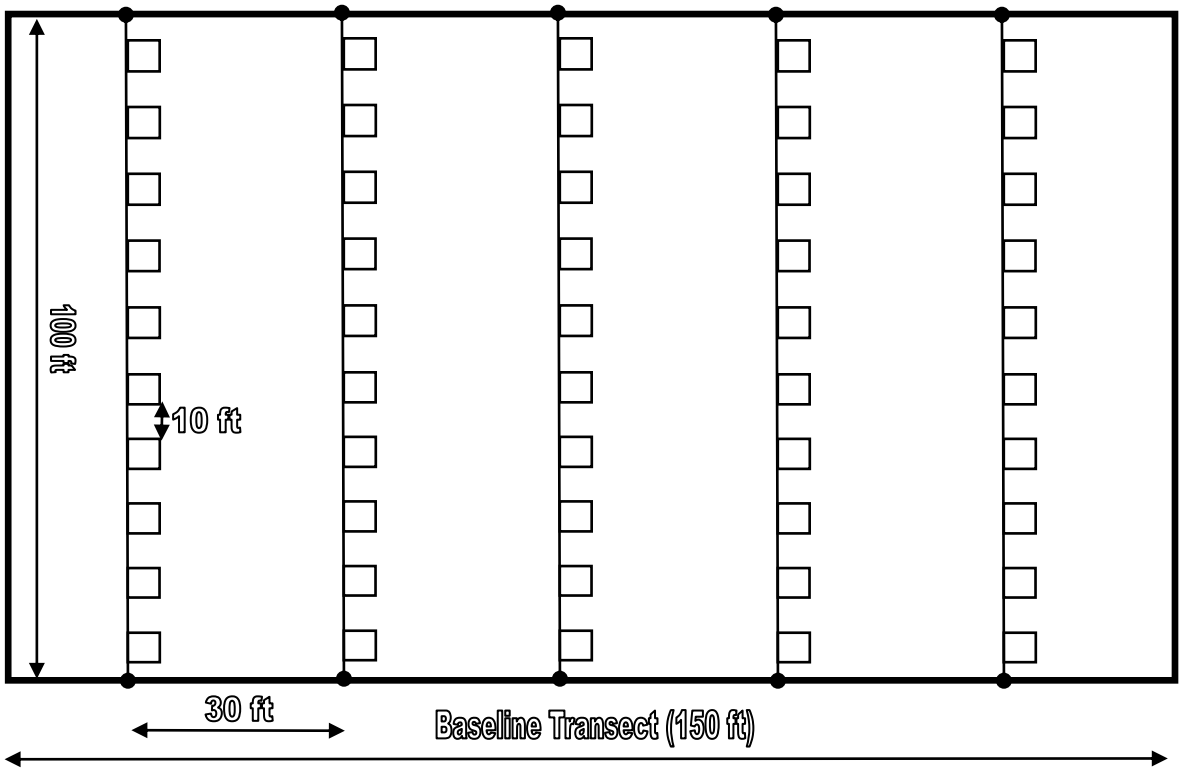

Figure 3. Macroplot Layout. Lines with dots are subtransects and squares are nested frequency sampling frame locations. Cover points not shown but include 50 pts/subtransect.

B. Sampling Design

A two-stage sampling design was employed in the Bryson Wash ESR project for quantifying vegetative response and treatment effectiveness. In other words, subtransects or macroplots can be analyzed as the sample unit. Sampling was stratified by SSURGO

soil map unit. All macroplots are randomly located in SSURGO Soil Map unit 2 because this was the predominant soil type treated.

Macroplots were subsampled by collecting data on five 100' subtransects. Subtransects were systematically located 30' apart within the macroplot with an initial random start between 0-28' (Fig. 3). Quantitative response variables measured at each subtransect include line-point intercept cover and nested frequency. Line-point intercept cover included 50 pts per transect and measured only the first hit for all grass, forb, shrub vegetation. Nested frequency frames included 10 frames per transect and measured all grass, forb, and shrub frequency. Density was not utilized as planned because of the prevalence of rhizomatous species for which individual counting units could not be defined.

C. Field Measurement Protocols

The baseline transect, at each plot location, is monumented with a T-post at the start and a 2' piece of rebar at the end. GPS locations for these monuments were collected using a Trimble GeoXT and differentially corrected to achieve maximum positional accuracy. A 150' tape measure is stretched between the two markers and 100' subtransect tapes are extended perpendicularly to this (Fig. 3).

Figure 4. Nested Frequency Sampling Frame.

Frequency was measured using a nested frequency frame with quadrat sizes of 24" x 24", 12" x 12", 6" x 6", and 3" x 3" (Fig. 4). The quadrat sizes were selected to be consistent with data collected by the range program in the Monticello Field Office. The sampling frame was placed 10 times along each subtransect every 10 feet starting at the 5 ft mark. All species rooted with greater than 50% of the plant base occurring within one of the nested quadrats were tallied. Refer to Measuring and Monitoring Plant Populations (Elzinga et al, 1998) for more information on nested frequency.

Cover was measured using the line-point intercept method (Bonham, 1989; Elzinga et al, 1998) using a pin flag. Cover points are a systematically placed, every two feet, along the subtransect starting at the two foot mark on the tape for a total of 50 points per subtransect. Only the top canopy hit was recorded for each point for all plants.

Repeat photography was taken at each of the plots. The T-posts are monumented with the ribbed side of the T-post pointing True North (i.e. no declination adjustment). This results in the three flanged edges pointing in the three other cardinal directions. Using the T-post as a guide or "tripod", by resting the camera on top, photographs were taken for each cardinal direction. Additional photographs were taken of plants present in the area.

D. Timing of Monitoring

Monitoring occurred prior to treatment and the first three growing seasons following treatment (Table 3).

Table 3. Westwater II Sample Events.

Monitoring Status	Macroplot 1	Macroplot 2	Macroplot 3	Macroplot 4	Macroplot 5
Pre Treatment	09/28/2006	10/24/2006	10/24/2006	10/27/2006	11/15/2006
1st Growing Season	12/05/2007	*	*	*	*
2nd Growing Season	09/11/2008	09/10/2008	09/10/2008	09/05/2008	09/09/2008
3rd Growing Season	06/08/2009	06/11/2009	06/11/2009	06/12/2009	06/12/2009

***Sites not sampled due to inaccessible stream crossing.**

E. Monitoring Location

Monitoring occurred within the Westwater II burn perimeter (Table 4). The Westwater II burn is accessed by driving North from Moab, Utah along highway 191 to Crescent Junction. At Crescent Junction travel eastbound along Interstate 70 until you reach Exit 214 (formerly Exit 212). Take the exit and navigate to the dirt road that parallels I-70 for approximately 2.75 miles. You will come across an intersection where you will go right (southwest) which you will follow into the burn. From there use the inset on the attached map (Appendix A) to navigate to the burn.

Five macroplots were sampled within SSURGO Soil Map unit 2. One of the five plots was an untreated control plot.

Table 4. Westwater II Macroplot Locations.

Macroplot	Northing (m)*	Easting (m)*	Elevation (ft)
Macroplot 1 Start	4322151.5	655391.8	4453
Macroplot 1 End	4322179.3	655428.1	4461
Macroplot 2 Start	4322601.2	658699.4	4675
Macroplot 2 End	4322557.3	658714.0	4686
Macroplot 3 Start	4322461.1	659149.4	4696
Macroplot 3 End	4322484.0	659189.0	4697
Macroplot 4 Start	4323777.2	659859.1	4729
Macroplot 4 End	Unknown	Unknown	Unknown
Macroplot 5 Start	4322270.7	659217.1	4688
Macroplot 5 End	4322227.7	659236.6	4686

**UTM Zone 12 North NAD83*

F. Intended Data Analysis Approach

Summary statistics will be calculated on the frequency and cover data. Simple means, proportions, standard deviations, standard errors, and confidence intervals will be calculated and compared to objectives. A T-test may be used to compare different

treatment means in an attempt to find significant differences in the measured variables. T-values will be used instead of Z-values because of the small sample size.

VII. Data Sheet Example

See Appendix B.

VIII. Management Implications of Potential Results

The results of the monitoring program may show either treatment success or failure. If the results of this monitoring project show that the drill seeding treatment was unsuccessful in meeting objectives then several considerations need to be addressed.

First, the objectives need to be evaluated to determine if they were reasonable given the soil type, precipitation zone, range/ecological site, fire severity, timeframe and type of treatment. If, in hindsight, they are deemed unrealistic then future projects may still be implemented and successful within the framework of an altered set of objectives. If the objectives are deemed appropriate in a post-hoc consideration then future drill seedings under similar conditions should not be implemented.

Second, if monitoring data show that certain species exhibited greater levels of germination, establishment, and persistence over others and that increasing seeding rates of these species might meet objectives, then future projects may be successful with an altered seed mix.

Third, the monitoring data may show treatment failure in certain areas where implementation of the seeding was the cause of failure. In other words, seeding may have been successful in certain areas but not in others due to an implementation failure of not applying seed uniformly throughout the project area. In this case reapplication of the seed in these areas may be performed.

IX. Summary of Results

See Table 4 below for a key to the species codes and functional groups. Only the 24”x 24” frequency quadrat and the first pin flag intercept were analyzed.

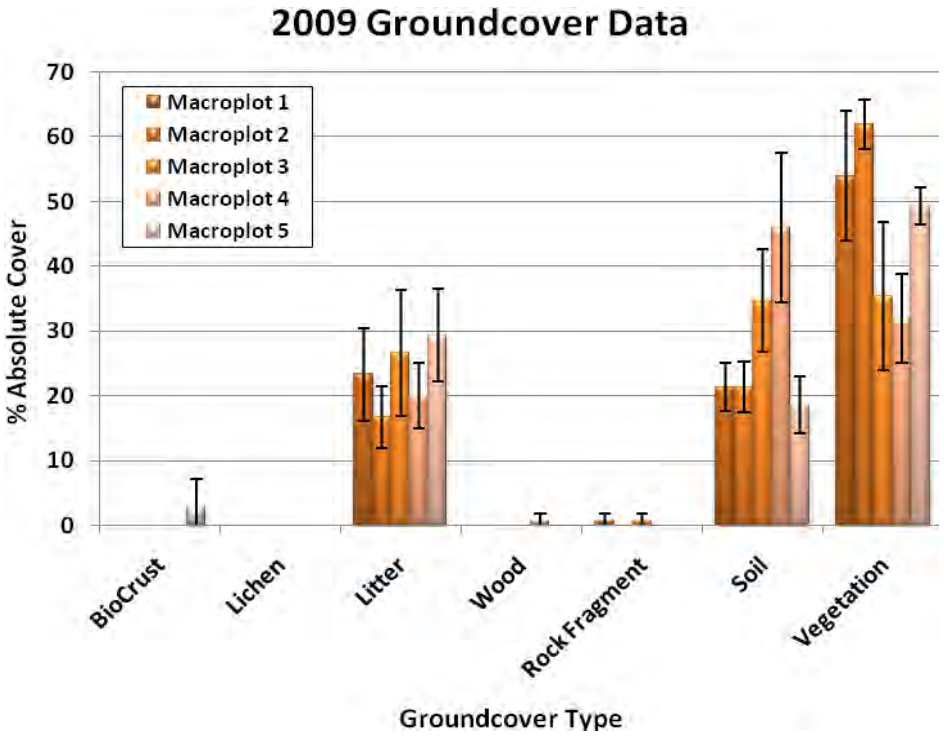

Figure 5. Absolute Percent Cover of Ground Cover Types in 2009. Error bars show 90% confidence intervals.

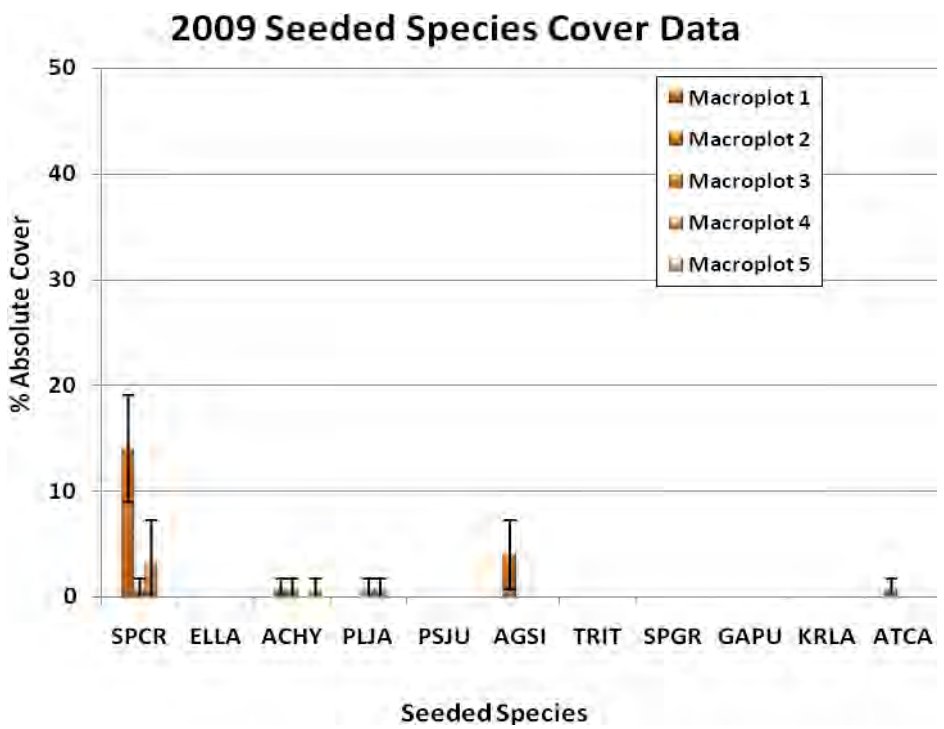

Figure 6. Absolute Percent Cover of Seeded Species in 2009. Error bars show 90% confidence intervals.

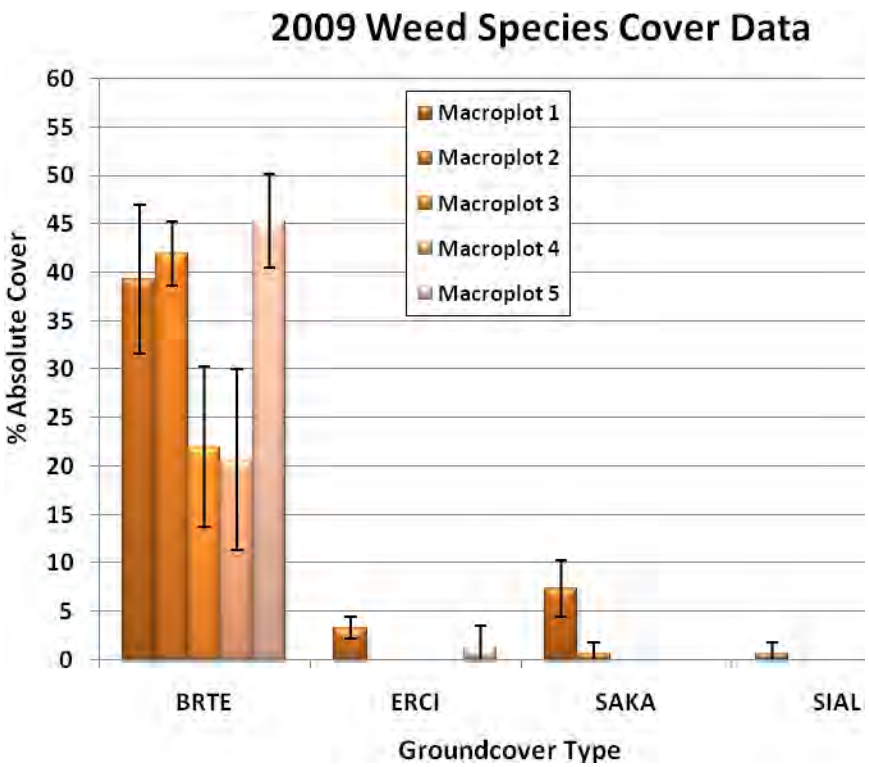

Figure 7. Absolute Percent Cover of Weed Species in 2009. Error bars show 90% confidence intervals.

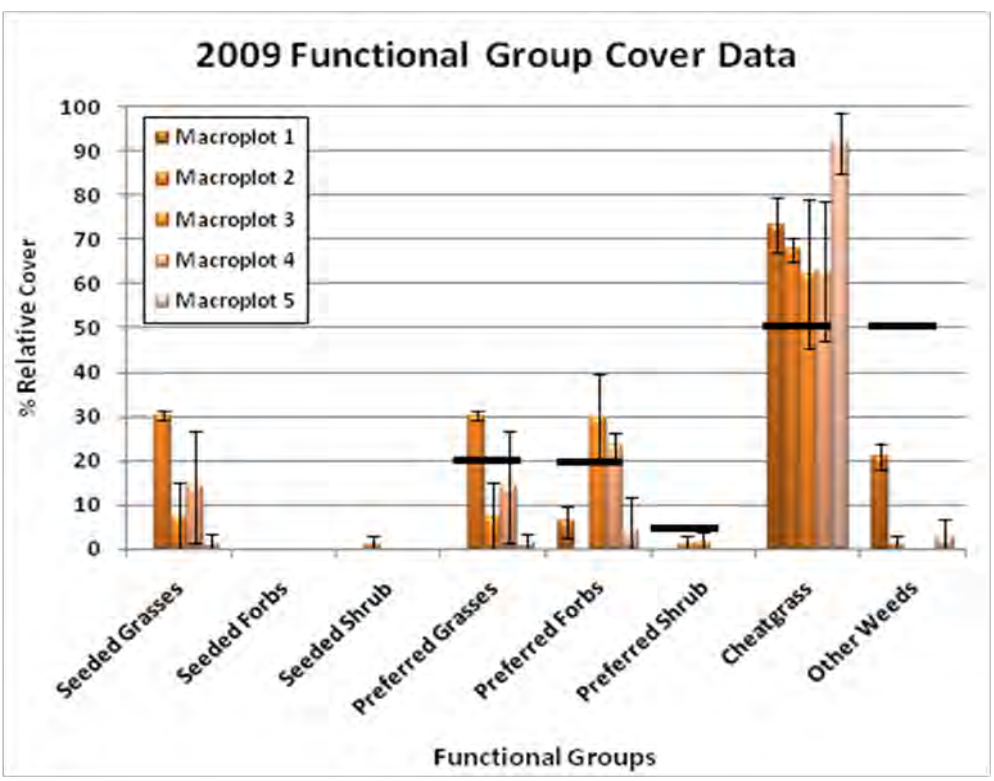

Figure 8. Relative Percent Cover of Functional Groups in 2009. Black lines show objective thresholds and error bars show 90% confidence interval.

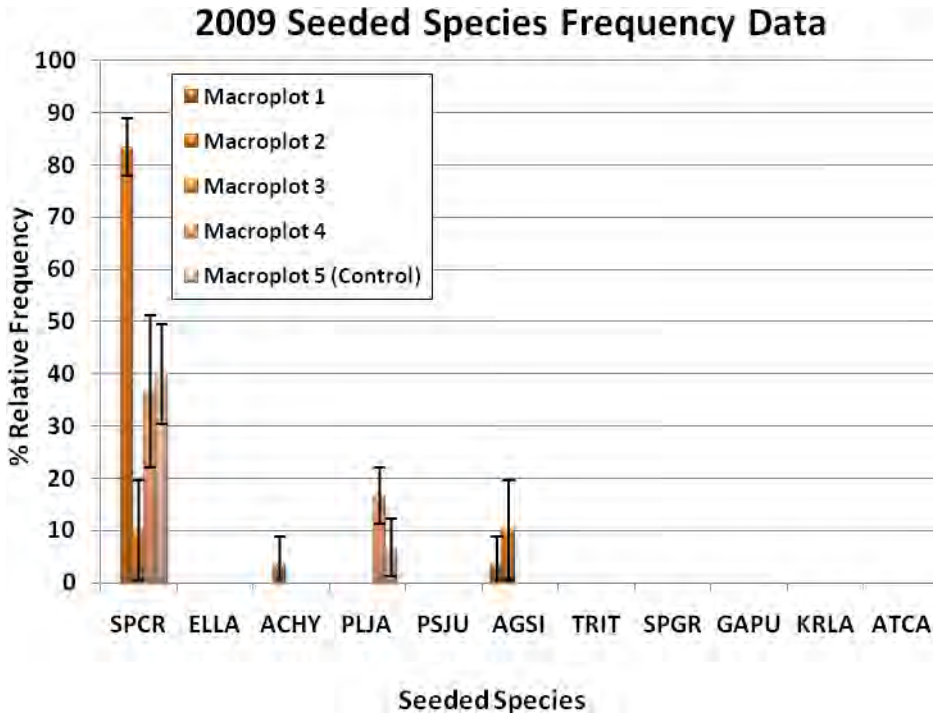

Figure 9. Relative Frequency of Seeded Species in2009. Error bars show 90% confidence interval.

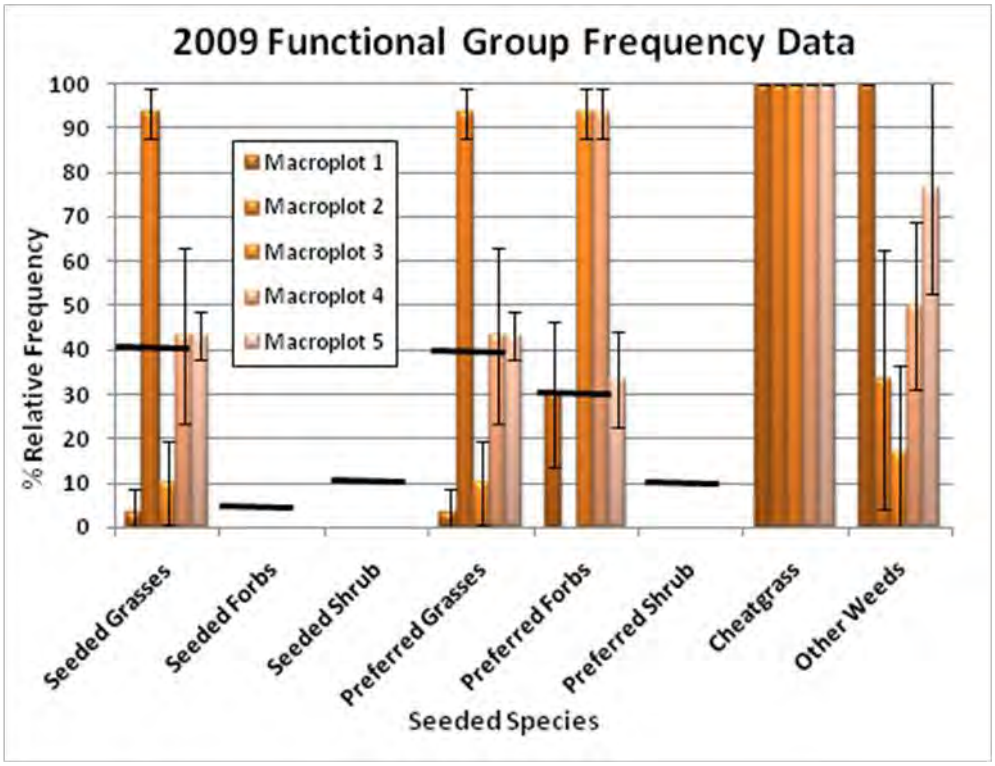

Figure 10. Relative Frequency of Functional Groups in 2009. Black lines show objective thresholds and error bars show 90% confidence interval.

Table 4. Key to Species Codes and Functional Groups

Species Code	Common Name	Scientific Name	Functional Group	
SPCR	Sand Dropseed	*Sporobolus cryptandrus*	**Seeded Grasses**	**Preferred Grasses**
ELLA	Thickspike Wheatgrass	*Elymus lanceolatus*		
ACHY	Indian Ricegrass	*Achnatherum hymenoides*		
PLJA	Galleta Grass	*Pleuraphis jamesii*		
PSJU	Russian Wildrye	*Psathrostachys juncea*		
AGSI	Siberian Wheatgrass	*Agropyron sibericum (P-27)*		
TRIT	Triticum species	*Triticum spp.*		
VUOC	Sixweeks Fescue	*Vulpia octoflora*		
SPGR	Gooseberryleaf Globemallow	*Sphaeralcea grossularifolia*	**Seeded Forbs**	**Preferred Forbs**
GAPU	Blanketflower	*Gaillardia pulchella*		
SPPA	Small flowered Globemallow	*Sphaeralcea parviflora*		
CHER2	Rose Heath	*Chaetopappa ericoides*		
IPAG	Scarlet gilia	*Ipomopsis aggregata*		
MACA	Hoary tansyaster	*Machaeranthera canescens*		
OEPA	Pale Evening Primrose	*Oenothera pallida*		
ATCA	Fourwing Saltbush	*Atriplex canescens*	**Seeded Shrubs**	**Preferred Shrubs**
KRLA	Winterfat	*Krascheninnikovia lanata*		
GUSA	Broom Snakeweed	*Gutierrezia sarothrae*		
BRTE	Cheatgrass	*Bromus tectorum*		**Weeds**
ERCI6	Redstem Stork's Bill	*Erodium cicutarium*		
SAKA	Russian Thistle	*Salsola kali*		
SIAL2	Tall Tumblemustard	*Sisymbrium altissimum*		
LAMA9	Margined Sticktight	*Lappula marginata*		

X. Interpretation of Results

A. Objectives

The *Management Cover Objective for Overall Vegetative Recovery* was *marginally successful* in meeting the objective threshold for preferred grasses and forbs but completely failed for shurbs (Fig. 8). For preferred grasses, only macroplot 2 occurring in soil map unit 54, met the 20% objective threshold while the other four plots including the control plot (macroplot 5) failed. For preferred forbs, only two of the seeded macroplots had relative cover values greater than the 20% threshold. The preferred shrub objective was not met within any macroplot. This is likely due to the longer timelines typically required for shrub recruitment, establishment and growth.

The *Management Frequency Objective for Overall Vegetative Recovery* was marginally successful for preferred grasses and preferred forbs but was completely unsuccessful for preferred shrubs (Fig. 10). For preferred grasses, only macroplot 2 was clearly above the 40% frequency threshold. The Macroplot 4 mean was slightly above the threshold although the confidence interval drops significantly below. Additionally, macroplot 4 and the control have the same mean indicating that natural regeneration is involved. For preferred forb, two seeded plots were clearly over the threshold while a third is borderline. The control also hovers around the threshold again indicating natural regeneration is involved, indicating that the seeding treatment, while augmenting the native recovery, is not solely responsible for meeting these objectives. Although seen in small numbers within a few macroplots, very few preferred shrubs were captured using quantitative methods.

The *Management Cover Objective for Treatment Effectiveness* focused on limiting the relative cover of annual weeds to less than 50% (Fig. 8). This objective was *not met* by any of the five macroplots including the control. However, the control plot had 19% greater relative cheatgrass cover than do the seeded plots. It is the opinion of this author, that under unseeded conditions the relative cover of cheatgrass would still be greater than 50% but the seeding has had both an ecological and statistical effect on reducing cheatgrass cover by establishing seeded species. Other weed relative cover is negligible on all but macroplot 1 where it approaches 22 % on the site.

The *Management Frequency Objective for Treatment Effectiveness* was marginally successful for seeded grasses but was completely unsuccessful for seeded forbs and shrubs (Fig. 10). For seeded grasses, only macroplot 2 was clearly above the 40% frequency threshold. The Macroplot 4 mean was slightly above the threshold although the confidence interval drops significantly below. Additionally, macroplot 4 and the control have the same mean indicating that natural regeneration is involved. The treatment was not successful in establishing seeded forbs or shrubs. Seeded forbs and shrubs did not perform well and this portion of the objective was not met.

B. Other Results

The following bullets represent some other conclusions that can be drawn from this monitoring project:

- SPCR, PLJA, AGSI and ACHY are establishing (Fig. 6, 9).
- Seeded forbs and seeded shrubs failed (Fig. 8, 10).
- Vegetative response different among different soils (see below).

The vegetative response appears to be different among different soils. However, there is not enough replication to determine this with scientific certainty. Interestingly, seeded grasses performed best within macroplot 2 (Fig. 10) in the Rock outcrop-Arches-Mido soil complex (Soil Map Unit 2) with statistical certainty. Macroplot 1, located within the Nakai-Redlands complex of soils (Soil Map Unit 42) showed the worst recruitment and establishment of both the seeded and naturally occurring species. Macroplot 3, 4, and 5 (control) were all located within the Begay-Sazi complex of soils (Soil Map Unit 4) and the Semidesert Sandy Loam range site and had been burned by the Little Hole fire in 1999. When compared to the control, the seeded macroplots within this soil map unit had:

- Lower frequency of other weeds (Fig. 10).
- Statistically lower absolute and relative cheatgrass cover (Fig. 7, 8).
- Statistically higher frequency of preferred forbs (Fig. 8).
- Higher cover of seeded grasses (Fig. 8).

It is unclear why these trends are present.

XI. Management Recommendations

A. Change in Management

Seedings in the Nakai-Redlands complex of soils should be undertaken with caution as results here were poor. Seeding of grass species in Rock outcrop-Arches-Mido soil complex achieve reasonable success.

B. Change in Monitoring

The Westwater II ES&R monitoring project was successful in providing an understanding of the treatment effectiveness of the drill seeding. Important aspects to the monitoring plan included the incorporation of quantitative methods, random sampling, soil stratification and control plots. However, several changes to future ES&R monitoring programs are recommended to increase sampling efficiency, statistical rigor,

and to bring the Canyon Country Fuels ES&R program in line with the national monitoring standardization effort.

Sampling efficiency could be improved by decreasing the subsampling intensity within each macroplot. In this project, five subtransects were sampled within each macroplot and a reduction to three subtransects is recommended. The Rattle Fire Complex Remote Sensing Report (Bissonette and White, 2008) showed that subsampling intensity could be reduced to three or four subtransects with satisfactory results in generating the cheatgrass cover regression model created for that project. A notable difference between the Rattle ES&R project and the Westwater II ES&R project is that the diversity was far greater within Rattle. The use of three subtransects per plot in the lower plant diversity system of the Westwater II ES&R project seems further justified.

Statistical rigor would be increase by increasing the number of macroplots to better capture the variability within the Westwater II ES&R project. This is a common issue for land management agencies due to the limited time and money available for monitoring the large number of projects. However, increasing the number of macroplots per strata to three or four is recommended. A reduction in the amount of subsampling, as mentioned previously, will provide a cost savings that can be used to increase the number of macroplots on the landscape.

ES&R project monitoring has been criticized by the Government Accountability Office (GAO) because the methods currently employed throughout the Department of Interior (DOI) are dissimilar and do not often establish treatment success/failure. There has been considerable thought and effort applied to establishing a common approach to monitoring ES&R projects (Wirth and Pyke, 2007a) to address these shortcomings. Monitoring ES&R projects will follow the methodology outlined by Wirth and Pyke (2007b) with a small modification. Seeded rhizomatous species are often not easily quantified using density because defining an individual is problematic. Therefore, the density quadrat will be used as a frequency frame and frequency collect for seeded rhizomatous species.

XII. References

Bissonette, G.J., White, M.A. 2008. Rattle Fire Complex Emergency Stabilization and Rehabilitation Remote Sensing Report. Bureau of Land Management, Moab Field Office. 23 p.

Bonham, C.D. 1989. Measurements for terrestrial vegetation. John Wiley and Sons, New York. 338 p.

Elzinga, C.L., Salzer, D.W., and Willoughby, J.W. 1998. Measuring and Monitoring Plant Populations. USDI Bureau of Land Management Technical Reference 1730-1. 492 p.

Hansen, D. T. 1989. Soil Survey of Grand County, Utah. Natural Resource Conservation Service, United States Department of Agriculture.

Wirth, T.A., Pyke, D.A., 2007a. Monitoring Post-fire Vegetation Rehabilitation Projects-A Common Approach for Non-forested Ecosystems: U.S. Geological Survey Scientific Investigations Report 2006-5048, P. 36.

Wirth, T.A., Pyke, D.A., 2007b. Standardized Emergency Stabilization and Rehabilitation Monitoring Protocols. **U.S. Department of Interior, U.S. Geological Survey Forest and Rangeland Ecosystem Science Center.** http://fresc.usgs.gov/research/esrmonitoring/Links.htm.

XIII. Authors and Reviewers

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Brian Keating:
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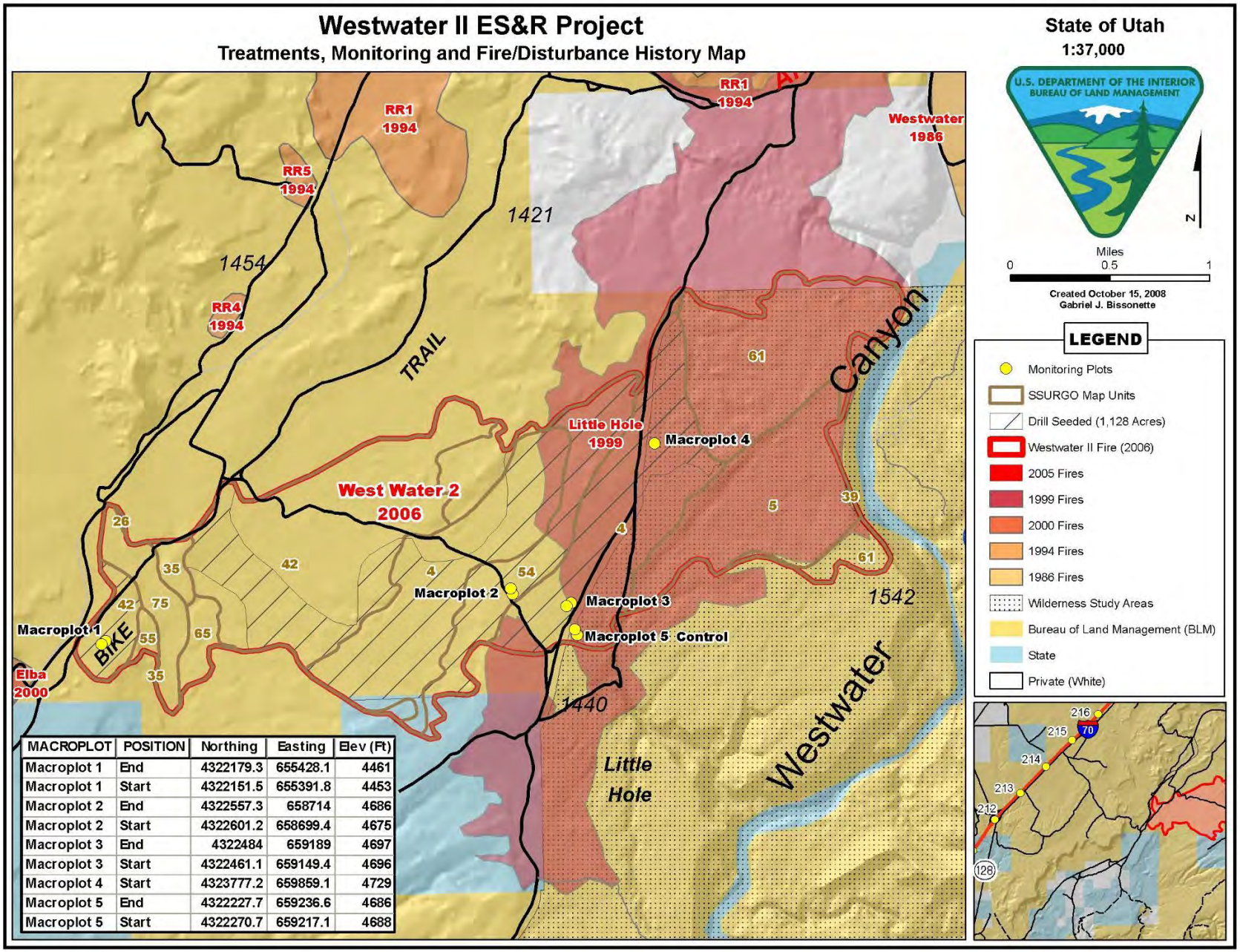
Appendix A - Project Map



MACROPLOT	POSITION	Northing	Easting	Elev (Ft)
Macroplot 1	End	4322179.3	655428.1	4461
Macroplot 1	Start	4322151.5	655391.8	4453
Macroplot 2	End	4322557.3	658714	4686
Macroplot 2	Start	4322601.2	658699.4	4675
Macroplot 3	End	4322484	659189	4697
Macroplot 3	Start	4322461.1	659149.4	4696
Macroplot 4	Start	4323777.2	659859.1	4729
Macroplot 5	End	4322227.7	659236.6	4686
Macroplot 5	Start	4322270.7	659217.1	4688

Appendix B - Data Sheets

UTM:

Nested Frequency

Study Site:	Date:	Examiner:	Recorder:
Main Transect Location & Length:	Number of quadrats: 10 on each subtransect		Quadrat size: 24" x 24"
Sub Transect Location & Length:	Sampling Interval:		
Design: random systematic	Subtransects read on	of baseline	Quadrats read on: of subtransect

Transect #:	Located at:	Random Quadrats start at:	Quadrat Interval:	Transect #:	Located at:	Quadrat Random Start at:	Quadrat Interval:

	Quadrats										Quadrats									
Plant Species, Soil Crust, Etc.	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10

Appendix C – Repeat Photography

Westwater II ES&R Macroplot 1 North – September 28, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 1 North – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 1 North – December 5, 2007 (1st Growing Season)

Westwater II ES&R Macroplot 1 North – September 11, 2008 (2nd Growing Season)

Westwater II ES&R - Macroplot 1 North - June 8, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 1 South – September 28, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 1 South – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 1 South – December 5, 2007 (1st Growing Season)

Westwater II ES&R Macroplot 1 South – September 11, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 1 South – June 8, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 1 East – September 28, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 1 East – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 1 East – December 5, 2007 (1st Growing Season)

Westwater II ES&R Macroplot 1 East – September 11, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 1 East – June 8, 2009 (3rd Growing Season)

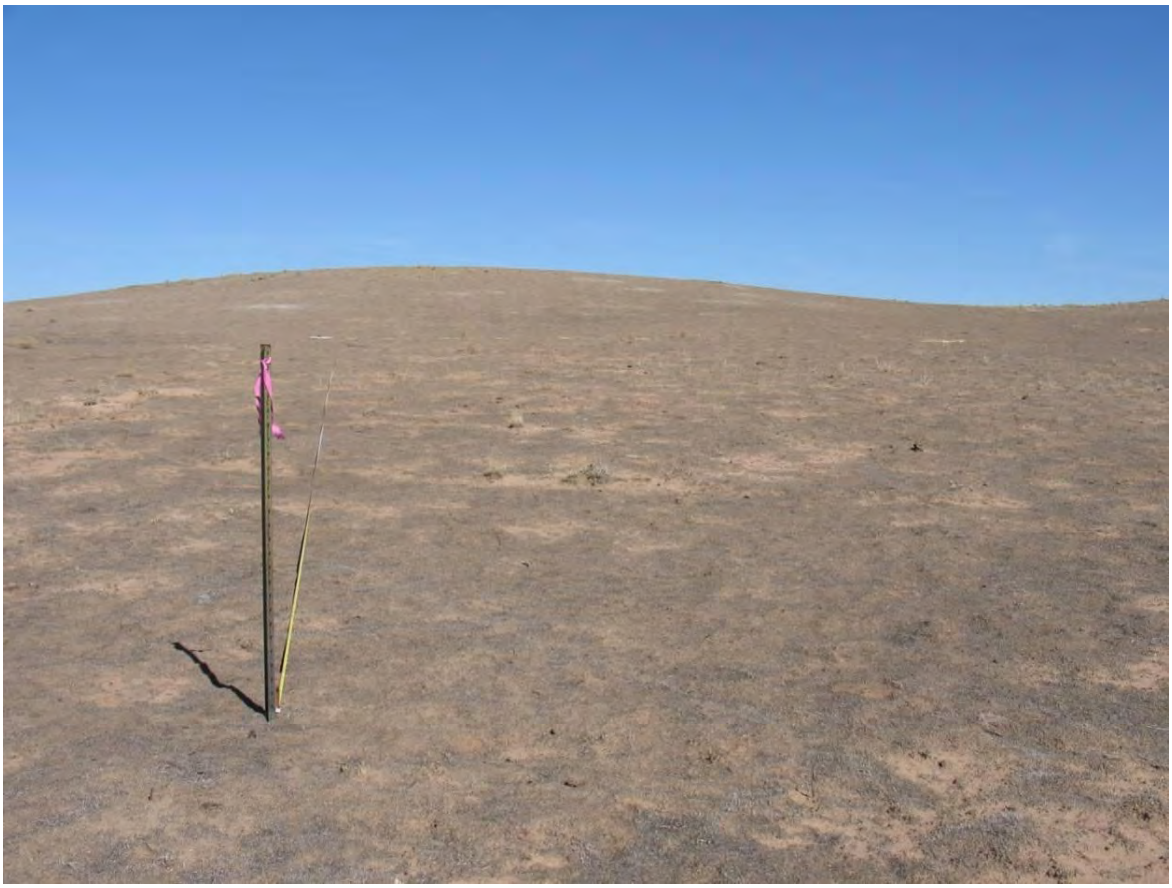
Westwater II ES&R Macroplot 1 West – September 28, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 1 West – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 1 West – December 5, 2007 (1st Growing Season)

Westwater II ES&R Macroplot 1 West – September 11, 2008 (2nd Growing Season)

Westwater II ESR Macroplot 1 West – June 8, 2009



Westwater II ES&R Macroplot 1 Plotview – September 28, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 1 Plotview – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 1 Plotview – December 5, 2007 (1st Growing Season)

Westwater II ES&R Macroplot 1 Plotview – September 11, 2008 (2nd Growing Season)

Westwater II ES&R Macroplot 2 North – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 2 North – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 2 North – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 2 North – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 2 South – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 2 South – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 2 South – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 2 South – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 2 East – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 2 East – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 2 East – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 2 East – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 2 West – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 2 West – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 2 West – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 2 West – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 2 Plotview – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 2 Plotview – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 2 Plotview – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 2 Plotview – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 3 North – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 3 North – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 3 North – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 3 North – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 3 South – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 3 South – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 3 South – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 3 South – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 3 East – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 3 East – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 3 East – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 3 East – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 3 West – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 3 West – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 3 West – September 10, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 3 West – June 11, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 3 Plotview – October 24, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 3 Plotview – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 3 Plotview – September 10, 2008 (2nd Growing Season)

Westwater II ES&R Macroplot 4 (WSA) North – October 27, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 4 (WSA) North – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 4 (WSA) North – September 5, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 4 (WSA) North – June 12, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 4 (WSA) South – October 27, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 4 (WSA) South – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 4 (WSA) South – September 5, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 4 (WSA) South – June 12, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 4 (WSA) East – October 27, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 4 (WSA) East – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 4 (WSA) East – September 5, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 4 (WSA) East – June 12, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 4 (WSA) West – October 27, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 4 (WSA) West – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 4 (WSA) West – September 5, 2008 (2nd Growing Season)

Westwater II ES&R – Macroplot 4 (WSA) West – June 12, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 4 (WSA) Plotview – October 27, 2006 (Pre-treatment)

Westwater II ES&R Macroplot 4 (WSA) Plotview – November 15, 2006 (Post-treatment)

Westwater II ES&R Macroplot 4 (WSA) Plotview – September 5, 2008

Westwater II ES&R – Macroplot 4 (WSA) Plotview – June 12, 2009 (3rd Growing Season)

Westwater II ES&R Macroplot 5 (Control) North – November 15, 2006

Westwater II ES&R Macroplot 5 (Control) North – September 9, 2008

Westwater II ES&R – Macroplot 5 (Control) North – June 12, 2009

Westwater II ES&R Macroplot 5 (Control) South – November 15, 2006

Westwater II ES&R Macroplot 5 (Control) South – September 9, 2008

Westwater II ES&R – Macroplot 5 (Control) South – June 12, 2009

Westwater II ES&R Macroplot 5 (Control) East – November 15, 2006

Westwater II ES&R Macroplot 5 (Control) East – September 9, 2008

Westwater II ES&R – Macroplot 5 (Control) East – June 12, 2009

Westwater II ES&R Macroplot 5 (Control) West – November 15, 2006

Westwater II ES&R Macroplot 5 (Control) West – September 9, 2008

Westwater II ES&R – Macroplot 5 (Control) West – June 12, 2009

Westwater II ES&R Macroplot 5 (Control) Plotview – November 15, 2006

Westwater II ES&R Macroplot 5 (Control) Plotview – September 9, 2008

Westwater II ES&R – Macroplot 5 (Control) Plotview – June 12, 2009