Rabbit Creek Seed Study: Project Design and Implementation

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Boise
National
Forest

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INTRODUCTION

How we manage our land, a natural resource, is changing. In the past, resource management agencies: Department of Interior's Bureau of Land Management (BLM), National Park Service (NPS), and Department of Agriculture's Forest Service (USFS), have used non-native species for revegetating areas after a disturbance.

As awareness and knowledge increases, federal agencies and the private sector are realizing the vital role native vegetation plays in maintaining a healthy, properly functioning ecosystem. Natural ecosystems support an array of biotic diversity, and native vegetation is a fundamental part of that system. Recently, natural resource managers are beginning to make the move from seeding with introduced species, which have widespread adaptability, to native species in order to maintain or restore genetic and ecological integrity of native ecosystems (Richards et al. 1998). Restoring areas of disturbance to historical conditions has become a priority.

The Idaho Conservation Data Center (IDCDC) is currently working with the Boise National Forest (BNF) in collecting native seeds for a variety of road restoration projects across the BNF (Miller and Rust 2002, 2003, 2005). In 2003, IDCDC collected approximately 170.5 kg (376 lbs) of unprocessed native seed in the Rabbit Creek drainage, which is located on the Idaho City Ranger District. The seed is to be used specifically for road restoration work, within the area, beginning in 2004. Collected seed is a mixture of grasses and sedges, shrubs, and forbs.

The purpose of this study is to assess the effectiveness of local native plant material (seed or propagules) collections in meeting restoration objectives in the Rabbit Creek drainage. Objectives will be met through planning, designing, implementing, and monitoring field studies on the quality and suitability of plant materials collected in the Rabbit Creek. The study will focus on 1) maximizing slope stability, 2) initial establishment of natural native plant populations and communities, and 3) prevention of further invasion of noxious weed species. Specifically, it will investigate the influence of 1) the use of seed vs. rooted plugs (subject to availability), 2) straw vs. no straw on plant establishment and growth, and 3) the invasion of invasive or noxious weed plant establishment.

STUDY AREA

The study area is located approximately 15 km (9 miles) east of Idaho City, Idaho, within the project boundaries of the Rabbit Creek Watershed Improvements/Roads Management Project on the Idaho City Ranger District, BNF (Figures 1 and 2). In August 2004, 3 study sites within the Rabbit Creek drainage, were identified by BNF and IDCDC staff. The individual study sites are identified as 1) X322AX10, 2) 322A (1), and 3) 322A (2) (Figure 3), and are located on secondary roads (labeled for road restoration) off of Forest Service Road 322, a primary road that follows the North Fork of Rabbit Creek. Sites were chosen on their similarities (i.e. slope, aspect, elevation) and ease of accessibility. Location (UTM coordinates) and environmental parameters for each study site are listed in Table 1.

Maps: The Rabbit Creek drainage study area is found on the 7.5 minute series USGS topographical quadrangle map, Rabbit Creek Summit.

Climate: Weather data from Idaho City, Idaho is the closest approximation of climatic conditions at the site. Precipitation and temperature data are available from 1931 through 2004. The average maximum temperature ranges from 31.17^{o} C (88.1^{o} F) to 25^{O} C (77.1^{o} F) during June through September. The average minimum temperature occurs in January (-10.7^{o} C (12.7^{o} F)). The area receives most of its precipitation November through February with December and January being the highest months (9.19 cm (3.62 in) and 9.22 cm (3.63 in), respectively). Annual snow depth for the area is 12.7 cm (5 in) (Western Regional Climate Center, 2003).

Geology: The Rabbit Creek study area lies within the Idaho batholith, which is the largest geological feature of the Boise National Forest. The batholith was formed in the Cretaceous period of the Mesozoic era approximately 63 to 135 million years ago. Character of rocks and rock material

include: granite, quartz monzonite, monzonite, grandodiorite, quartz diorite, and diorite (Bond and Wood 1978).

METHODS

Vegetation monitoring in the Rabbit Creek study area is designed to collect trend data. We refer to trend data as the direction of change, and it is used to determine whether or not a study area is moving away from or towards its potential and /or specific management objectives (Bureau of Land Management 1985). Monitoring practices will be replicated at each of the 3 study sites over the next 2 years and are designed to collect the following information: 1) plant species germination and establishment frequency will be monitored and compared to the rate of seeding/planting and 2) comparison of treatments in promoting growth of native species and naturally regenerating natives and noxious weeds in treatments.

Nested plot frequency method

To detect changes in vegetation over time, the nested plot frequency method will be used to describe the abundance and distribution of the vegetation sampled. The nested plot frequency method is desirable when collecting data on different species of various sizes, and is defined by calculating the number of times a species occurs in a given number of sampling units (Lutes et al. In Press; Bureau of Land Management 1985 and 1996; Mancuso 2002; and Elzinga et al. 1998). Frequency information will be collected for vascular plant species, litter, and bare soil from 4 microplot nested plot frame sizes in each cell: 10 x 10 cm; 50 x 50 cm; 50 x 100 cm; and 100 x 100 cm. A plant species must be rooted within the microplot to be counted (Appendix 1 and 2).

Point intercept method

The point intercept method is another sampling procedure used to monitor changes in plant species cover and height and/or ground cover over time. The method is appropriate when sampling forbs, grasses, and shrubs less than 1m (3 ft) in height (Lutes et al. In Press; Bureau of Land Management 1985 and 1996; Elzinga et al. 1998). A point frame designed to sample live vegetation as either a hit (foliar cover) or miss will be used. In all, 36 fixed points with an interval of 20 cm (3.94 in) will be sampled in each cell. At points where no live vegetation exists (miss), the ground surface cover (litter, bare soil, gravel, and wood) will be recorded. At every point, the height, in meters, of each recorded plant species will be measured. Mosses and lichens will also be recorded if present (Appendix 5 and 6).

The comparison of treatments in promoting growth of native species and naturally regenerating natives and noxious weeds in treatments will be addressed using the point intercept method.

Reproductive status

Each plant species recorded at a fixed point will be assigned to 1 of 3 life stage class categories: 1) Reproductive stage class (R) - the individual plant has flowers or fruits; 2) Non-reproductive stage class (N) – the individual plant is non flowering/fruiting and is obviously not a seedling; or (3) Seedling (S) – the individual plant is a tiny germinant, typically <2 cm (.79 in) in height (Mancuso and Miller 2003).

Photo-points

Photo-points are photographs of landscape or features retaken from the same place so differences in vegetation can be compared between years (Elzinga et al. 1998). A photograph of each cell will be taken during each monitoring visit of each year. Photos will be taken from the outside edge (north side- cells 1-15 and south side- cells 16-30) of each column at the midpoint of each cell.

A blocked experimental design to control the influence of the environmental variation will be employed. Study sites will be marked with permanent markers (rebar), hammered into the ground marking the 2 ends (East and West) and the middle of the block design. Within each study site, a

45.72 m (150 ft) area (the shaded area of Figure 4), 30 individual cells will be laid out randomly in 2 columns. Each 1.5 m^2 (4.92 ft^2) cell is immediately adjacent to one another, and a 0.5 m (1.64 ft) walkway will divide the 2 columns. A 0.25 m (.82 ft) buffer will be applied within each cell during monitoring resulting in a 1 m^2 (3.28 ft^2) cell that is actually sampled. Buffers are also present on the east and west ends of the study sites separating the sites from the contractor's seed treatments 210A and 210C (Figure 4). By emplacing buffers (to keep each treatment distinct), we should get a good representation of each seed treatment (Figure 5).

There are 5 seed treatments in all, and 3 replications of each treatment will be employed per study site. The seed treatments include: 1) native seed, 2) native seeds with plugs, 3) native seed with contractor's road seed mix, 4) contractor's road seed mix, and 5) no seed. One-half of the treatments will be covered with weed-free straw (Figure 6).

Native seed used in 3 out of the 5 seed treatments was collected in the project boundaries of the Rabbit Creek Watershed Improvements/Roads Management Project at approximately (5000 ft, +/- 500 ft). An (1000 ft) elevation band was employed thus resulting in an elevation range from (4500 ft) to (5500 ft). All seed was processed at BNF-Lucky Peak Nursery (LPN) (Appendix 3). Native seed (a mixture of forbs and graminoids) was selected on availability, abundance, hardiness, and rapid development (grasses). Eight species were selected: 2 graminoids; *Agropyron spicatum* (bluebunch wheatgrass) and *Carex hoodii* (Hood's sedge), and 6 forbs; *Achillea millefolium* (yarrow), *Penstemon fruticosus* (bush penstemon), *P. humilis* (low beardtongue), *Potentilla glandulosa* (sticky cinquefoil), *Lupinus sericeus* (silky lupine), and *Eriogonum heracleoides* (parsnipflower buckwheat). All seed with the exception of *Carex hoodii,* were selected from multiple seed lots collected either in 2003 or 2004. Seed was then tetrazolium tested (TZ-tested), which is a fast, reliable test to determine seed viability (Elias and Garay 2004).

Table 2 is a chart listing the seed species, source, elevation, and calculations of the amount of seed used in treatments. The amount of native seed used is based on Pure Live Seed (PLS), which is the product of the percentage of germination plus the hard seed and the percentage of pure seed divided by 100. Seeds are placed into 1 of 2 categories; 1) < 500,000 seeds per pounds and 2) > 500,000 seeds per pounds where typically 20-30 seeds/ft^2 is used for larger seed (1) and 40-50 seeds/ft^2 is used for smaller seed (2), and/or rates have been modified based on past research (Ogle et al. 2003). All species range from 45% (*Potentilla glandulosa*) to 97% (*Achillea millefolium*) in percent germination, and have $\geq$ .98 purity. Appendix 4 gives a brief summary of Table 2.

Due to the extent of this restoration project and large quantities of native seed from the local source not being available, short-lived "native cultivars" of *Bromus marginatus* (mountain brome), variety "Garnet" and *Elymus trachycaulus* spp. *trachycaulus* (slender wheatgrass), variety "Pryor" were selected. These 2 grass cultivars are referred to as the contractor's seed mix, and are in 2 seed treatments (210A and 210C) at each study site. Seed was applied at 20 lbs/acre. Contractor's seed mix that was added to native seed treatment (C) was applied at 6 lbs/acre. This application rate was recommended by Granite Seed, which is an appropriate rate for allowing native seed establishment. It is expected that local endemic grasses and sedges, forbs, shrubs, and trees will become established as these "native cultivars" diminish. The PLS for the contractor's seed mix has the minimum requirement for percent of germination (85%).

Plugs of *Carex geyeri* (elk sedge) will be added to treatment 2 during the 2005 field season (subject to availability). The number and placement of plugs have not yet been determined. However, if plugs are not available then treatment 2 will be considered control plots.

The location of the West and East end (45.72 m (150 ft) strip) (Figure 4) and the rebar at the starting and ending points of each study site (Figure 5) will be documented in the field using navigation grade geographical positioning system (GPS) units (e.g., Garmin 12XL), and by hand on 1:24,000 USGS quadrangles. Soils are determined by digging shallow pits and performing a soil ribbon test following the procedures adopted by Foth et al. (1982) and National Soil Survey Center, USDA (1998) (Midwest Geosciences Group, 2004). Pictures will be taken throughout all phases of the study.

Each site was initially prepared by a contractor who was hired by the BNF. A brief synopsis of the contractor's protocol is as follows: Roadway treatment methods in accordance with specification section 210.03(a) method A, B, or C were used (USDA Forest Service 1996). The layout for the contractor's seed treatments 210A (contour, seed, and straw) and 210C (rip roadbed, and seed) is shown in Figure 4.

RESULTS

Site preparation began immediately after the contractor was finished, and took 2 days to complete (October 04 and 11, 2004). Sites were permanently marked (with rebar) at the following points: starting point (0.0 m/ft; northwest corner), 7.5 m (25.61 ft), 11.5 m (37.73 ft), 15.0 m (49.21 ft), and 22.5 m (73.82 ft) down both sides of each column. A total of 60 stakes were used 20 at each site (Figure 10). Rebar stakes stick up above ground approximately 5.08 to 12.7 cm (2 to 5 in) and the ends are painted red. After sites were prepped and set up, the block design was re-measured, checked for being square, and adjusted accordingly.

Each study site was raked and boulders, stones, cobbles, and clumps of vegetation were removed from the study area as best as possible (Figures 7–9). This preparation enabled us to work with a smoother surface which provided the following benefits: easier access within study site, 2) more precise measurements in cell layout, 3) ease of distributing seed treatments within each cell, and 4) ease of replicating cell layout in upcoming years. However, it must be noted that each study site was not prepped to the extent that the finished product is an entirely smooth, level surface. Microsites, small cobbles, and established vegetation still exist, and may have an affect on seed establishment and/or growth. Study site 322A (1) was extremely rocky and hard to prep, and has an established shrub growing in cell E3, which will be identified in 2005 field season.

Seed treatments were applied to each study site on October 21, 2004. A 1.5 m^2 (4.92 ft^2) device built out of pink insulating sheeting was constructed for the purpose of seed application. The apparatus was placed on the boundaries of each cell prior to seeding and straw application to ensure no overlapping of treatments occurred (apparatus can be seen in Figures 11-16). Seed was mixed according to treatment specifications prior to dispersal (Table 2). Treatments were then evenly scattered by shaking a legal-sized envelope (with a hole cut in one end) approximately 1 m (3.28 ft) above the cell. Seed hand broadcasters were not used due to the variety of seed size and the small amount of seed being distributed in each cell. Weed-free straw was then applied (by hand, approximately 2.54 to 5.08 cm (1 to 2 in) deep) according to treatment. In cells where no straw was applied the ground surface was roughed using the end of a shovel and then seed was applied and lightly covered with soil from that cell. In cells where straw was required soil was not roughed.

DISCUSSION

Local native plant materials, when available for restoration purposes, can expedite the return of healthy, functioning ecological systems. Likewise, native plant species help support the continued existence of native wildlife and fish. Endemic plant species form specialized relationships with their environment. In healthy circumstances and under a natural fire regime, these native plant species are better adapted to resist disturbance such as environmental changes (cold/drought tolerance), disease, insect infestations, and invasion by non-native plant species.

The BNF is dedicated to employ native plant materials for revegetation and restoration purposes in areas of disturbance across the Forest. This practice is in conjunction with the Forest Plan which emphasizes managing for biological diversity, maintaining the viability of native plant species and their communities, and the control of non-native plant species.

The native plant materials project is a study to test the efficiency of native seed and plant materials in revegetation and restoration of decommissioned or closed forest roads and/or trails at 3 study sites within the project boundaries of the Rabbit Creek Watershed Improvements/Roads Management Project, over the next 2 years. It is our goal to provide information on the performance of native plant material and their capabilities in: 1) maximizing slope stability, 2) initial

establishment of natural native plant populations and communities, and 3) prevention of further invasion of noxious weed species. Specifically, it will investigate the influence of 1) the use of seed vs. rooted plugs (subject to availability), 2) straw vs. no straw on plant establishment and growth, and 3) the invasion of invasive or noxious weed plant establishment of 8 native plant species. The project will help direct future efforts in native plant materials collection and restoration.

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Lists of Figures

Figure 1. An overview of the Boise National Forest showing the location of the Rabbit Creek Study area, which is located in the south-central portion of the Forest.

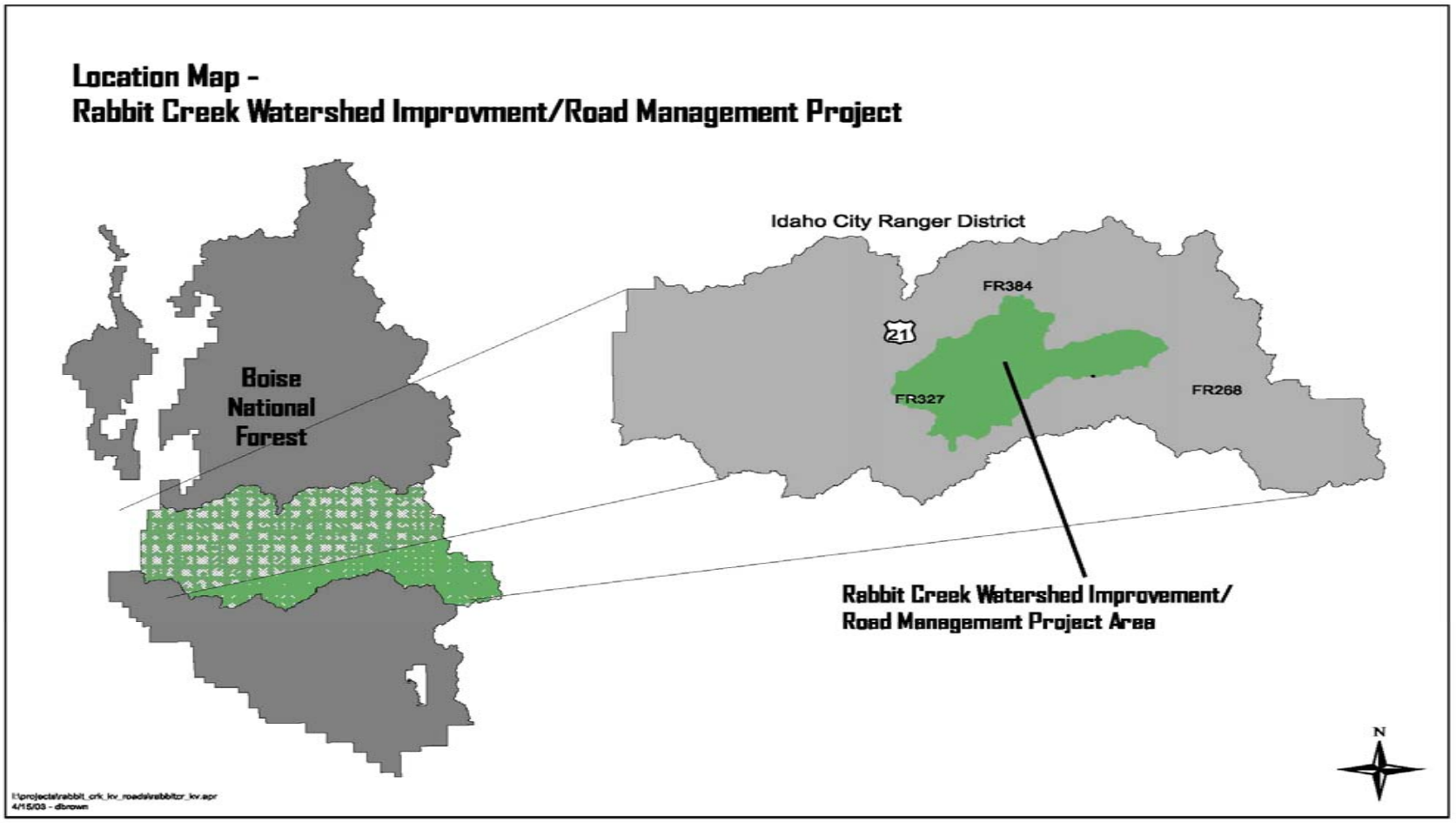


Figure 2. An overview of the Rabbit Creek Watershed Improvement/Road Management Project area located on the Boise National Forest in the Idaho City Ranger District.

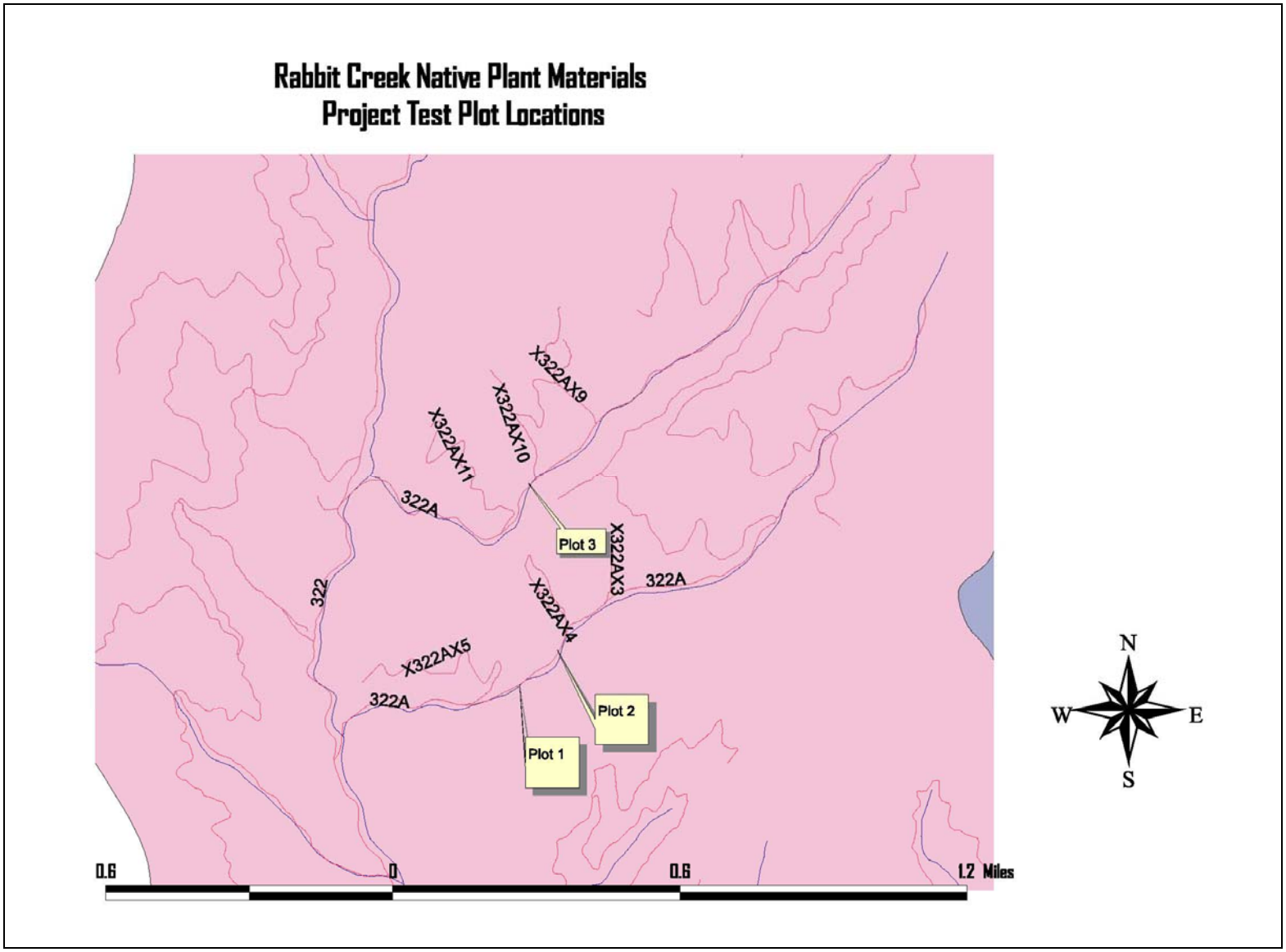
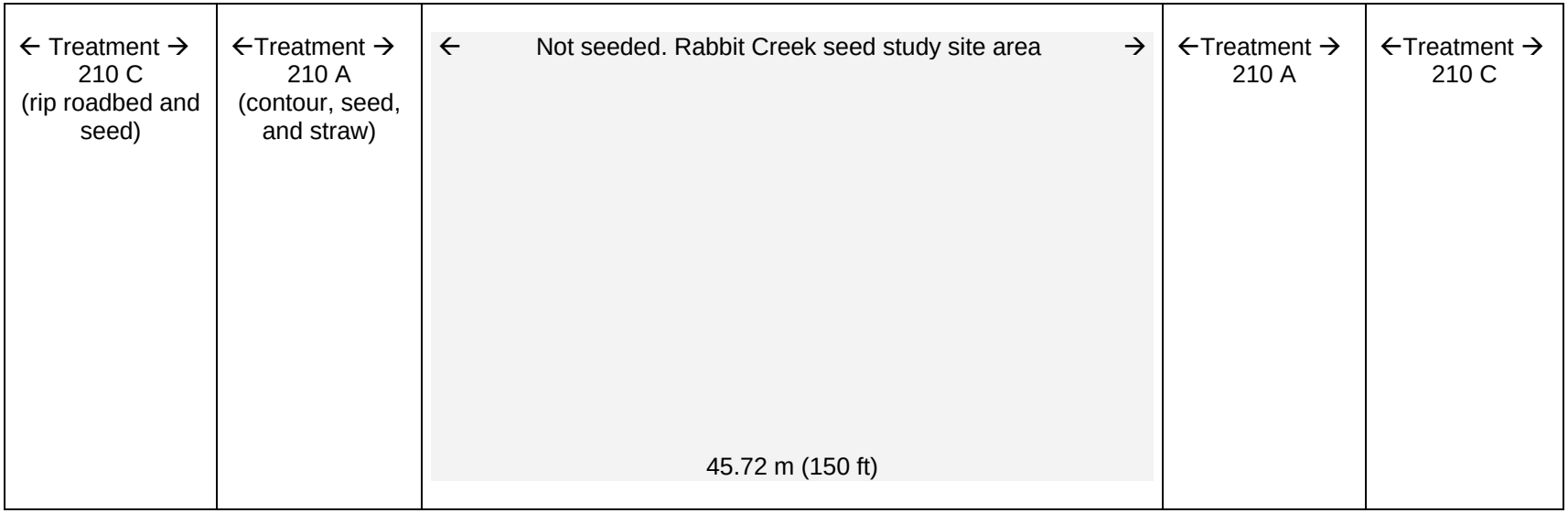


Figure 3. Approximate location of the 3 study sites within the Rabbit Creek Watershed Improvement/Road Management Project area. All test plot locations are located off of Forest Service Road 322, which follows the north fork of Rabbit Creek. Plot 1 = study site 322A (1), Plot 2 = study site 322A (2), and Plot 3 = study site X322AX1.



CONTRACTOR'S TREATMENTS:

210 A- Roadway is restored to approximately the original ground contour or shape to blend with surrounding terrain. Seed is applied with straw.

210 C- Roadbed is ripped at 30.48 cm (12 in) intervals to a minimum of 15.24 cm (6 in) depth with a multi-tooth ripper. Seed is applied without straw.

Figure 4. An overview of the contractor's layout at each study site. The entire length of the road bed was ripped.

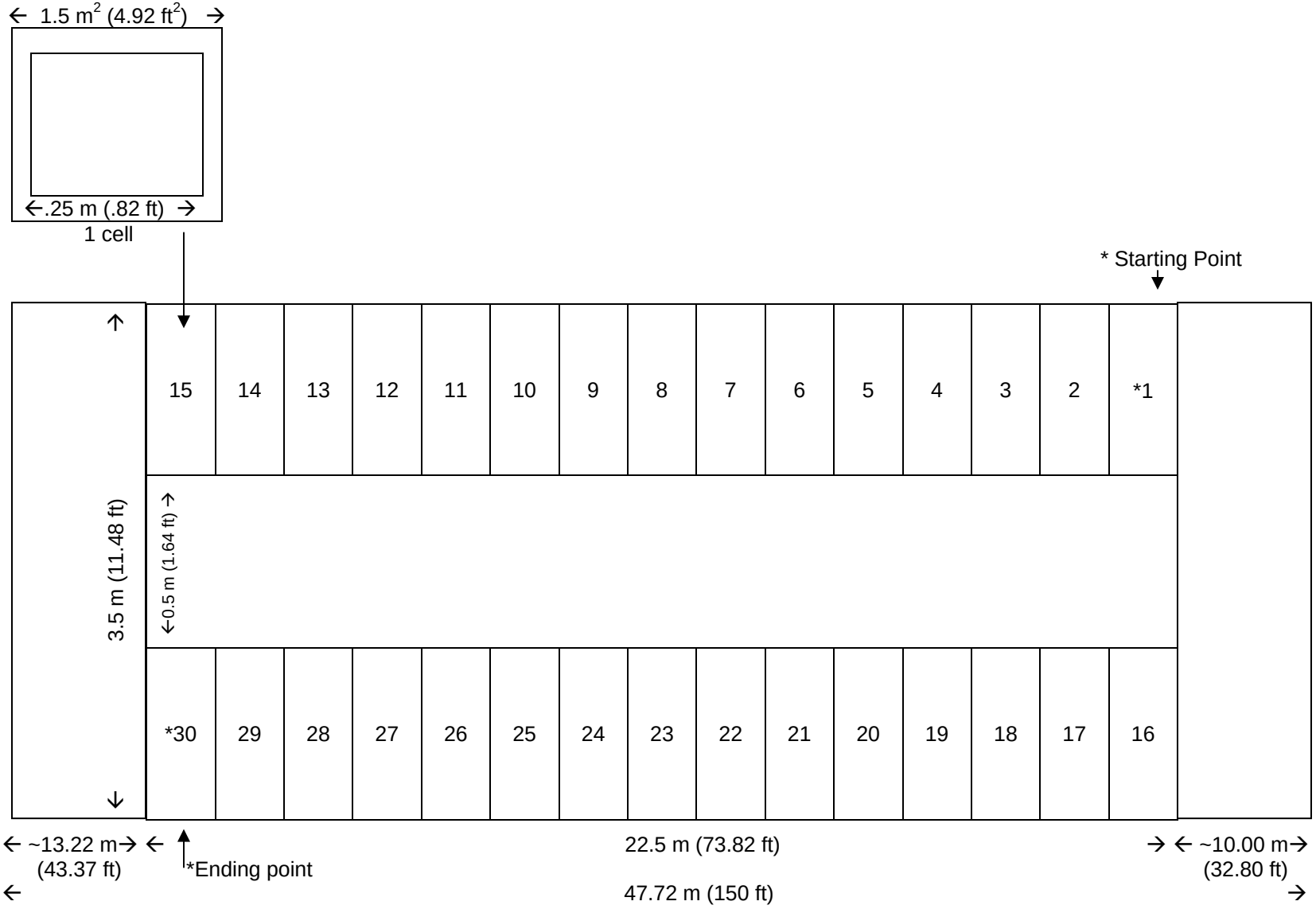
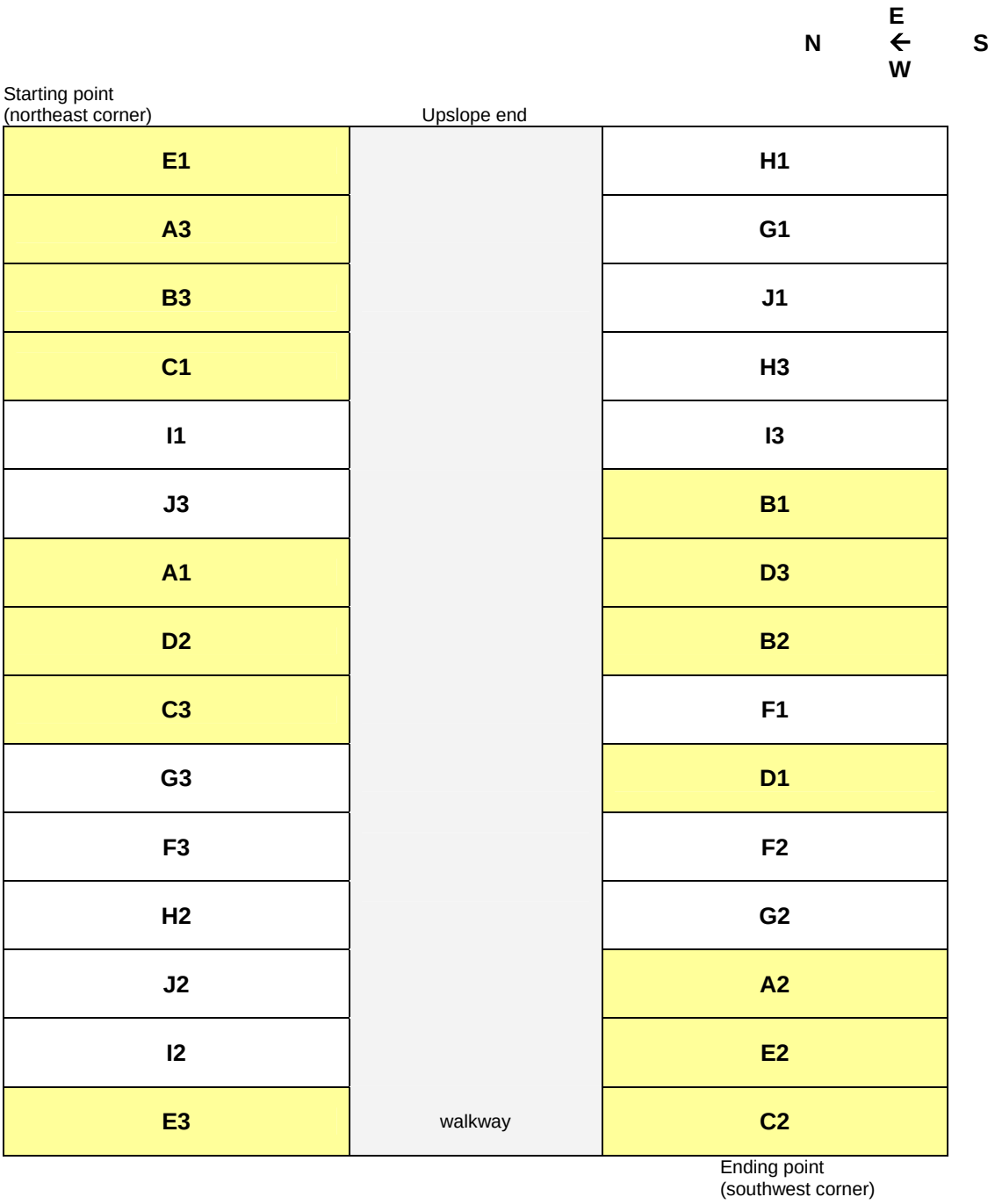


Figure 5. Detailed schematic of block design within each study area. Each cell has been numbered to show the quantity of cells at each site. This area fits within the shaded area in Figure 4. The dimensions of an individual cell is shown including the .25 m (.82 ft) buffer. Three replications of 5 seed treatments are being studied and is shown in more detail in Figure 6.



TREATMENTS FOR INDIVIDUAL CELLS:

STRAW	NO STRAW
A cells = native seed	**F** cells = native seed
B cells = native seed with plugs	**G** cells = native seed with plugs
C cells = native seed with contractor's seed mix	**H** cells = native seed with contractor's seed
D cells = contractor's seed mix	**I** cells = contractor's seed mix
E cells = no seed	**J** cells = no seed

Figure 6. Detailed illustration of the overall block design at each study site (322A (1), 322A (2), and X322AX10) within the Rabbit Creek drainage study area. Diagram depicts random cell placement and treatment. Each cell is 1.5 m^2 (cells not drawn to scale).

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Figure 7. Study site X322AX10 staked out for contractor before it is ripped.

Figure 8. Study site 322A (1) staked out for contractor before it is ripped.

Figure 9. Study site 322A (2) before it is ripped.

Figure 10. A picture of study site X322AX10 after being ripped by the contractor. Notice the unevenness of the soil surface. Permanent end markers were placed before raking.

Figure 11. Study site X322AX10 being raked by hand.

Figure 12. Study site 322A (1) being raked. Take note of the boulders, stones, and large cobbles that are on the perimeter, which are being removed from the area where cells will be set up. This was the rockiest study site.

Figure 13. Study site 322A (2) completely prepped with permanent markers in place.

Figure 14. Straw being distributed over cell C2 at study site 322A(1).

Figure 15. Completion of set-up at study site 322A (1).

Figure 16. Setting-up cells at study site 322A (2). Set-up started at cell E1, which is in the northeast corner (upslope end) of each study site.

Figure 17. Completion of set-up at study site 322A (2).

Figure 18. Completion of set-up at study site X322AX10.

Lists of Tables

Table 1. A detailed summary of the location, environmental parameters, and soil type of each study site.

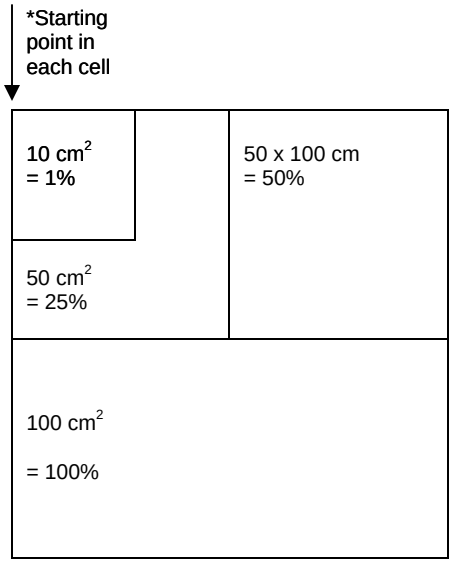
Study site	UTM coordinates		FOM±	Slope %	Aspect ^{0}	Elevation	Soil
	northing	**easting**					
	0605611	4854429	6.4				loamy sand
322A (1)	0605648	4854469	5.2	9	228	~5440	
322A (2)	To be given at a later date			6	195	~5440	loamy sand
	0605667	4855076	7.3				loamy sand
X322AX10	0605702	4855111	7.3	5	220	~5240	

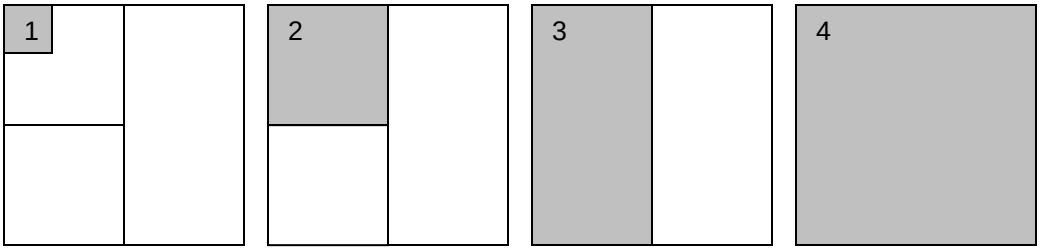
Table 2: A chart listing the seed species, source, elevation, and calculations of the amount of seed used in treatments.

Rabbit Creek Native Plant Materials Study																		10/14/2004	
Seed Origin	Collection Year	Species	Seed Source Code	Unprocessed seed (lbs)	Elevation (ft)	Cleaned Seed (g)	Cleaned Seed (lbs)	Number of Seeds per lbs	Total Seed Available (lbs)	Calculate Seed ft^2 @ 1 lb rate	Recommended rate PLS lb/acre	Recommened number PLS/ft^2	PLS/ft^2 with 8 seedlots	PLS/ Broadcast Rate	Number of seed needed per ft^2	Number of seed needed per 1.5 ft^2 (cell size)	Seed needed per cell (lbs)	Total Seed Needed (g) per cell	Total Seed Needed (lbs) per cell
Native seed		*Achillea millefolium*																	
	2003	Achmil	030612-1055	0.625	5000	14.04	0.03092511	3783333											
	2003	Achmil	030616-1156	0.9	5040	30.64	0.067488987	4540000											
	2003	Achmil	030616-1009	0.4	5060	3.06	0.006740088	3783333											
	2003	Achmil	030616-1354	0.6	5200	4.74	0.010440529	3242850											
	2003	Achmil	030609-1524	4.5	5240	4.02	0.008854626	4540000											
	2003	Achmil	030616-1156	1.4	5450	136.2	0.3	4540000											
			AM0203KV#1				Avg seed/lb	4071586	0.42	93.47	0.25	23.42	2.25	0.63	3.55	57.27	0.000014	**0.006**	0.0008
Native seed		*Agropyron spicatum*																	
	2003/2004	Agrspi	040715-1638	3.01	4900														
	2003/2004	Agrspi	040715-1549	5.62	4960														
		Agrspi	**AS0203KVRC**					161000	0.76	3.70	7.00	25.93	2.76	0.49	5.62	90.80	0.000564	**0.256**	0.0305
Native seed		*Carex hoodii*																	
	2003/2004	Carhoo	030826-1615	0.33	4930	46	0.101321586	366129	0.10	8.41	5.00	42.12	7.27	0.59	12.24	197.63	0.000540	**0.245**	0.0291
			CH0203KV99																
Native seed		*Eriogonum heracleoides*																	
	2003/2004	Eriher	030715-1549	0.4	4900	32	0.070484581	153378											
	2003/2004	Eriher	030715-1549	13.4	4900	52	0.114537445	150331											
	2003/2004	Eriher	030715-1638	1.4	4960	68.5	0.150881057	162142											
	2003/2004	Eriher	030612-1055	1.4	5000	251	0.552863436	177341											
	2003/2004	Eriher	030609-1524	4.5	5240	20.6	0.045374449	165715											
			EH0203KV41				Avg seed/lb	161781	0.93	3.71	6.00	22.34	2.04	0.55	3.69	59.53	0.000368	**0.167**	0.0199
Native seed		*Lupinus sericeus*																	
	2003	Lupser	030715-1549	11.25	4900	6	0.013215859	384 seeds											
	2003	Lupser	030715-1638	0.4	4960	97 seeds													
	2003	Lupser	030611-1051	5.4	5000	21.4	0.047136564	27784											
	2003	Lupser	030612-1055	3.5	5000	11	0.024229075	31267											
	2003	Lupser	030609-1524	5.5	5240	10.7	0.023568282	26518											
			LS0203KV49				Avg seed/lb	28523	0.11	0.65	15.00	9.84	0.40	0.44	0.91	14.72	0.000516	**0.234**	0.0279
Native seed		*Penstemon fruticosus*																	
	2003/2004	Penfru	030611-1213	8.6	5160	13.89	0.030594714	1513333											
	2003/2004	Penfru	030616-1321	0.5	5160	10	0.022026432	1621428											
			PF0203KV81				Avg seed/lb	1567381	0.05	35.98	1.00	36.06	5.33	0.44	12.05	194.61	0.000124	**0.056**	0.0067
Native seed		*Penstemon humilis*																	
	2003/2004	Penhum	030611-1213	5.25	5160	5.93	0.012995595	945833											
	2003/2004	Penhum	030610-1215	8	5200	14.89	0.032599119	908000											
	2003/2004	Penhum	03610-1305	11.3	5200	21.62	0.047356828	908000											
			PH0203KV52				Avg seed/lb	920611	0.09	21.13	2.00	42.37	7.35	0.63	11.73	189.40	0.000206	**0.093**	0.0111
Native seed		*Potentilla glandulosa*																	
	2003	Potgla	030731-1514	0.33	5040	31.6	0.069603524	2063636											
	2003	Potgla	030610-1305	2.4	5200	16.3	0.035903084	2063634											
	2003	Potgla	030610-1215	7.3	5200	2.7	0.005947137	1621428											
	2003	Potgla	030610-1305	8	5200	46	0.101321586	1621428											
	2003	Potgla	030609-1524	5	5240	26.8	0.059030837	1746153											
			PT0203KV21				Avg seed/lb	1823256	0.27	21.71	1.00	41.95	7.21	0.30	24.28	392.07	0.000215	**0.098**	0.0116
								<500,000 seed/lbs			Sum	244.04	**34.61**						
								>500,000 seed/lbs											
Contractor seed		Slender Wtgrass/ Mt Brome	**Contract Seed Only**								20.00			0.84			0.0088	**4.006**	0.1588
Contractor seed		Slender Wtgrass/ Mt Brome	**Native/ Contract mix**								6.00			0.84			0.0026	**1.202**	0.0477

List of Appendices

Appendix 1. A Layout of the nested plot frequency method within each 1.5 m^2 cell. The nested plots will fit inside of each cell allowing for the .25 m buffer on all sides. We will only record data within the $1m^2$ sampling area of each cell. This visual layout is taken from Firemon





Microplot number for rooted frequency	Size of microplot	Percent area of a 100 x 100 cm cell
1	Smallest, 10 x 10 cm	1 percent
2	50 50 cm	25 percent
3	50 x 100 cm	50 percent
4	Largest, 100 x 100 cm	100 percent

Illustrations and table are taken from Lutes et al. (In Press).

Appendix 2. Nested Plot Frequency field form.

Rabbit Creek Seed Study Plot information collection form-
Nested Plot Frequency Data Form-

Date: _____ **Study site:** _____ **Examiner (s):** _____
(X322AX10, 322A (1), or 322A (2))

UTM coordinates: _____ **Pictures:** _____ **Quad Map: Rabbit Creek Summit**

Species	Cell #																													Frequency Summary (%)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4
bare soil																																		
litter																																		
Achillea millefolium																																		
Agropyron spicatum																																		
Carex hoodii																																		
Eriogonum heracleoides																																		
Lupinus sericeus																																		
Penstemon fruticosus																																		
Penstemon humilis																																		
Potentilla glandulosa																																		
Slender wheatgrass																																		
mountain brome																																		

Comments: _____

1 = 10 x 10 cm 2= 50 x 50 cm 3 = 50 x 100 cm 4 = 100 x 100 cm

Appendix 3. Summary of native seed cleaned at Lucky Peak Nursery. The purpose and machinery used is noted.

Species	Purpose	Equipment	Manufacturer	Purpose	Equipment	Manufacturer	Purpose	Equipment	Manufacturer	Purpose
	Dry down fruit, stem, etc for ease of processing	Drying rack	LPN fabrication	Separate seed from fruit with minimal abrasion to seed	Handtumbler	LPN fabrication	Remove the "beards" from the seed	De-winger	UDSA Forest Service MTDC	Separate seed from fruit
Agropyron spicatum	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	
Carex hoodii	**x**	**x**	**x**							**x**
Achillea millefolium	**x**	**x**	**x**							
Penstemon fruiticosus	**x**	**x**	**x**	**x**	**x**	**x**				
Penstemon humilis	**x**	**x**	**x**	**x**	**x**	**x**				
Potentilla glandulosa	**x**	**x**	**x**							**x**
Lupinus sericeus	**x**	**x**	**x**							**x**
Eriogonum heracleoides	**x**	**x**	**x**							**x**

Equipment	Manufacturer	Purpose	Equipment	Manufacturer	Purpose	Equipment	Manufacturer	Purpose	Equipment	Manufacturer
De-winger	UDSA Forest Service MTDC	Separate seed from fruit	Scalper	JW Hance	Separate seed from chaff	Office Clipper	Ferrell-Ross	Separate full seed from empty seed	Air separator	Barnes Tree Improvement Co.
								x	x	x
x	x				x	x	x	x	x	x
		x	x	x	x	x	x	x	x	x
					x	x	x	x	x	x
					x	x	x	x	x	x
x	x				x	x	x	x	x	x
x	x				x	x	x	x	x	x
x	x				x	x	x	x	x	x

Appendix 4. Brief summaries are provided for all columns in Table 2. Table 2 refers to seed used for all treatments.

Seed Origin: Refers to seed either being native or contractor's seed mix.

Collection Year: Native seed was collected in either 2003 only or 2003 and 2004.

Species: Lists native species used in seed treatments. Two graminoids and 6 forbs were used.

Seed Source code: Code that links the seed to a native seed collection site within the project boundaries of the Rabbit Creek Watershed Improvements/Roads Management Project on the Idaho City Ranger District, Boise National Forest.

Unprocessed seed: Weight of seed collected upon delivery at Boise National Forest-Lucky Peak Nursery (seed that has not been cleaned).

Elevation: The elevation in feet determined at each native seed collection site.

Cleaned seed (g) and (lbs): Is the total seed per seedlot that has been processed by Boise National Forest-Lucky Peak Nursery. The average seed/lb is the mean weight of all seedlots combined of the same species.

Number of seeds per pound: Seeds per pound was calculated by taking 500 seeds, separating them into 5 piles of 100 seeds each and weighing each pile. The mean weight was then calculated. The size of seed was also determined: Large seed = <500,000 seeds/lbs (*Agropyron spicatum*, Carex hoodii, *Eriogonum heracleoides*, and *Lupinus sericeus*. These species are highlighted with green shading. Small seed = >500,000 seeds/lbs (Achillea *millefolium*, *Penstemon fruticosus*, *P. humilis*, and *Potentilla glandulosa*). These species are highlighted with orange shading.

Total seed available (lbs): The total weight (lbs) of seed available for study.

Calculate seed ft^2 at 1 lb rate: This calculation is based on seeds per square foot at a 1 pound/acre application rate (Ogle et al. 2003).

Recommended rate PLS lb per acre: This number is based on trying to achieve the rate of 50 seeds/ft^2 if seed is >500,000/lb or 25 seeds/ft^2 if seed is <500,000/lb. Some seed rates were adjusted on research findings. All numbers were taken from Ogle et al. 2003. *Achillea millefolium* and *Agropyron spicatum* rates were taken from research findings, and *Lupinus sericeus, Carex hoodii*, *Eriogonum heracleoides*, *Penstemon fruticosus*, *P. humilis*, and *Potentilla glandulosa* rates were compared to species with similar seed size and those rates were used. Rates are based on pure stand seeding.

Recommended number PLS/ft^2: The calculation is based on the recommended PLS seeding rate, multiplied by seeds per pound, and then divided by square foot per acre.

PLS/ft^2 with 8 seedlots: The calculation of the recommended PLS/ft^2, multiplied by the recommended PLS/ ft^2 per total. The calculation was based on proportions-i.e. the amount of large seed (<500,000 seeds/lb) and small seed (>500,000 seeds/lb) that was needed in each seed treatment per 1.5 m^2 cell.

PLS/Broadcast rate: Is the calculation of percent germination x purity (PLS) divided by 1.5 broadcast rate (additional seed is needed when broadcast seeding vs. drill seeding). The percent of germination and purity for each species as follows.

Species	Percent of germination	Purity
Native seed-		
Agropyron spicatum	96%	.98

Species	Percent of germination	Purity
Native species-		
Achillea millefolium	97%	.98
Carex hoodii	90%	.99
Eriogonum heracleoides	4%	.99
Lupinus sericeus	66%	.99
Penstemon fruticosus	67%	.99
Penstemon humilis	95%	.99
Potentilla glandulosa	45%	.99
Contractor seed-		
Bromus marginatus	85%	
Elymus trachycaulus spp. *trachycaulus*	85%	

Purity is the percent, by weight, of seed of the listed type. The calculated rule of thumb for purity is that 100% purity would not be used due to the fact that nothing is ever perfect.
*note- The process of scarification was not done on the *Lupinus sericeus* seed.

Number of seed needed per 1.5 m^2 (cell size): The calculation is the number of seed needed per square foot multiplied by number square feet divided by meter multiplied by 1.5 (cell size).

Seed needed per cell (lbs): The amount of seed needed per 1.5 m^2 cell in pounds.

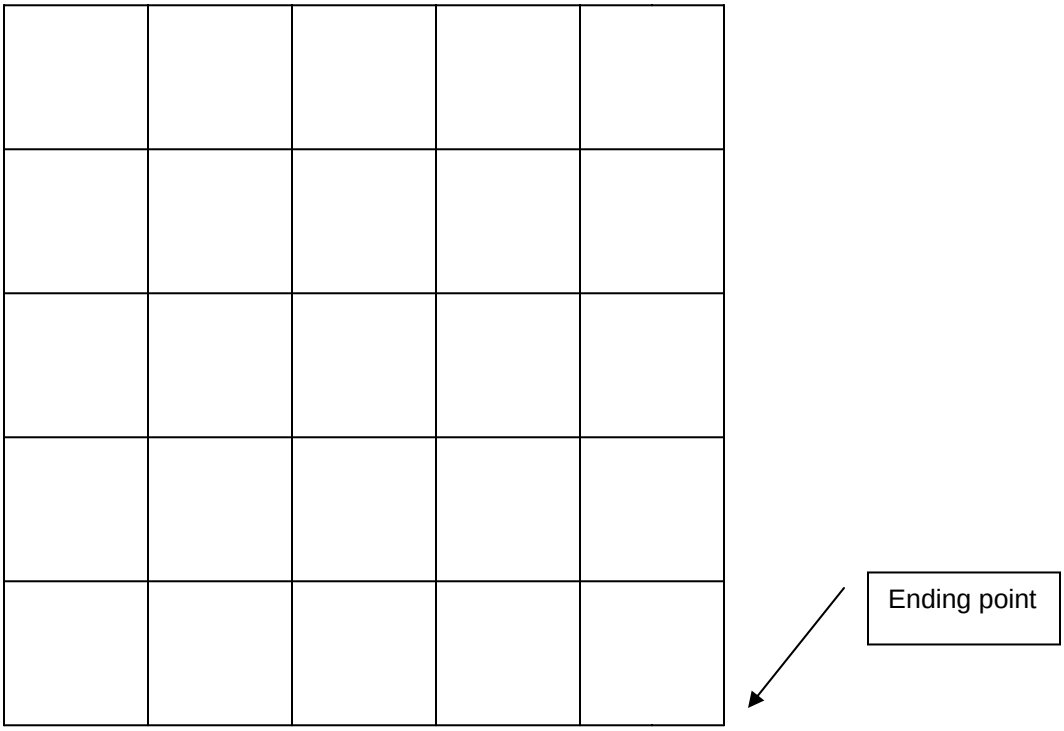
Total seed needed (g) per cell: The amount of seed needed per 1.5 m^2 cell in grams. There are 454 grams in 1 pound. Grams were calculated due to the small amount of seed needed per 1.5 m^2 cell.

Total seed needed (lbs): The number of 1.5 m^2 cells to be seeded multiplied by pounds of seed needed per cell.

Appendix 5. Layout of the point intercept method within each 1.5 m^2 cell. There are 36 fixed sampled points at a distance of 20 cm apart in the 1 m^2 sampling area per cell.

Starting point

Points are numbered from 1 to 36 (left to right) beginning at the starting point and finishing at the ending point.



Each point to be sampled is where a vertical and horizontal line intercepts (total 36 points at 20 cm intervals). The height and reproductive stage class will be recorded for each vegetative hit, and the ground cover will be recorded for each vegetative miss. A vegetative hit is based on foliar cover.

For example-

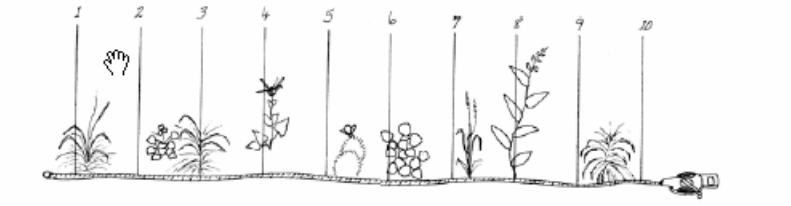


Figure PO-5. In this illustration points 1, 3, 4, 6, and 8 intersect plants and are recorded as "hits" for each species. Points 2, 5, 9 and 10 "miss" plants and are only recorded if ground cover is being sampled. Samplers will usually record just the first ground cover hit at each sampling point.

This illustration is taken from Lutes et al. (In Press).

Appendix 6. Plot Intercept field form.

Rabbit Creek Seed Study Plot information collection form- **cell:** _____ **Date:** _____
straw/no straw

Study site: (X322AX10, 322A (1), or 322A (2))- circle one **Examiner (s):** _____

Quad Map: Rabbit Creek Summit **UTM coordinates:** _____ **Pictures:** _____

Point	Ach mil	Agr spi	Car hoo	Eri her	Lup ser	Pen fru	Pen hum	Pot gra	slender wheatgrass	mountain brome	height	Reproductive stage class (R), (N), (S)	Litter	bare soil	gravel	cobble	wood												
1																													
2																													
3																													
4																													
5																													
6																													
7																													
8																													
9																													
10																													
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26																													
27																													

Point	Ach mil	Agr spi	Car hoo	Eri her	Lup ser	Pen fru	Pen hum	Pot gra	slender wheatgrass	mountain brome	height	Reproductive stage class (R), (N), (S)	Litter	bare soil	gravel	cobble	wood													
28																														
29																														
30																														
31																														
32																														
33																														
34																														
35																														
36																														

Comments: _____

Reference to Fixed area ecology plot data dictionary-IDCDC (Rev. 8/2004)
wood: ≥ 1/4 inch diameter
gravel: 0.2-10 cm (1/16-<3 inches)
cobble: 10-25 cm (3-<10 inches)