Rocky Flats Environmental Technology Site

Revegetation Plan

Revision 2

January 2004

Classification Exemption Number CEX-105-01

Introduction

The Rocky Flats Environmental Technology Site (Site) is undergoing decommissioning and closure. The decommissioning and closure activities include the removal of existing buildings and structures within the Industrial Area (IA) of the Site. As the buildings and other facilities and structures are removed, revegetation of the areas is needed to stabilize the soil, minimize erosion, and promote the establishment of native plant communities. In response to this need, Kaiser-Hill Company, L.L.C. (K-H) contracted Savage and Savage Inc. to prepare revegetation specifications for the Industrial Area. Savage and Savage produced the *Rocky Flats Environmental Technology Site Industrial Area Revegetation Plan* (Savage and Savage 2003). Kaiser-Hill Company developed revegetation specification sheets for the IA and the Buffer Zone using information contained within the Savage and Savage plan. The specification sheets and the Savage and Savage Plan were distributed for comment. The comments received are included in the Comment Responsiveness Summary located in Appendix A.

Based upon the Site's needs and the comments received, K-H has developed this *Rocky Flats Environmental Technology Site Revegetation Plan* (Plan). The Plan provides overall guidance and direction for revegetation activities in the IA and Buffer Zone areas at the Site. The revegetation specification sheets and an associated map of the IA are included in this Plan (Figure 1; Appendix B). However, for areas outside the IA (i.e. Buffer Zone) projects should contact the K-H Ecology Group for more information.

Goals And Objectives

This following goals and objectives were outlined for the Plan:

Goal 1. To provide a vegetative cover in disturbed/degraded areas to stabilize the soil and minimize erosion.

Goal 2. Wherever possible, avoid or minimize the loss of native habitat where it is still present.

Goal 3. Develop sustainable native plant communities that provide habitat for native wildlife species that occur at the Site. The goal is revegetation, not restoration (see note below).

Goal 4. Remove areas of planted, exotic plant species that were used for landscaping purposes.

Goal 5. Control noxious weeds in revegetation areas using an appropriate Integrated Weed Management Program (IWMP) strategy.

Goal 6. Improve methods for re-establishing native plant communities.

The purpose of this Plan is revegetation, not restoration. As defined for this Plan, revegetation is defined as reseeding the dominant native plant species for a given plant community type. This is in contrast to restoration, which is defined as the re-establishment of the pre-disturbance native plant communities and all the associated natural processes and functions.

Site Description And History

At an elevation of approximately 6,000 ft., the Site contains a unique ecotonal mixture of mountain and prairie plant species resulting from the topography of the area and its proximity to the mountain front. The Buffer Zone, the area surrounding the Industrial Area, is one of the largest remaining undeveloped tracts of its kind along the Colorado Piedmont. A number of plant communities present at the Site have been identified by the K-H Ecology Group and the Colorado Natural Heritage Program (CNHP) as increasingly rare and unique. These communities include the xeric tallgrass prairie, tall upland shrubland, wetlands, and Great Plains riparian woodland communities. Small inclusions of a number of other increasingly rare plant communities are also found on the Site.

The upper flat surfaces at the Site (pediment tops) are comprised of the Rocky Flats Alluvium. The soil types on this surface are classified as Flatirons very cobbly sandy loam and Nederland very cobbly sandy loam (SCS 1980). The vegetation on this surface is predominantly xeric tallgrass prairie on the western portions of the Site and gradually changes to a needle and threadgrass community as the alluvium thins to the east (Figure 1). Based on evidence from the current vegetation map and historical aerial photographs, much of the IA was probably xeric tallgrass prairie prior to its construction. Common species on the xeric tallgrass prairie include *Andropogon gerardii*, *Andropogon scoparius*, *Muhlenbergia montana*, *Stipa comata*, *Bouteloua gracilis*, *Bouteloua curtipendula*, *Carex heliophila*, *Poa compressa*, and a variety of other graminoid and forb species. The dominance of these species varies from location to location. Much of the IA occurs on this pediment surface and was predominantly xeric tallgrass prairie prior to disturbance.

The hillsides at the Site are dominated by the mesic mixed grassland community. Soils on the hillslopes are classified as Denver-Kutch-Midway clay loams (SCS 1980). Common species on the mesic mixed grasslands includes *Bouteloua gracilis*, *Bouteloua curtipendula*, *Agropyron smithii*, *Stipa viridula*, *Poa pratensis*, *Poa compressa*, *Bromus japonicus*, and other forbs and graminoids. The hillside areas in the IA are were largely composed of this community prior to disturbance.

Riparian areas at the Site are typically characterized by *Populus deltoides*, *Salix exigua*, *Amorpha fruticosa*, *Symphoricarpos occidentalis*, *Rosa arkansana*, and various wetland herbaceous plants such as *Carex nebrascensis*, *Juncus balticus*, and *Spartina pectinata*. The soils on the flood plains and stream terraces are classified as Haverson loams at the Site (SCS 1980). Within the IA, historical aerial photographs show that two small tributaries to Walnut Creek drained the IA and would have contained some wetland and riparian vegetation. These tributaries, however, were modified and the channels moved for construction of some of the buildings at the Site.

Prior to purchase by DOE most of the land where the Site occurs was rangeland that had been heavily overgrazed (Clark 1980). Historical aerial photographs show little riparian woodland or shrubland vegetation along the streams at the Site, likely attributable to overgrazing in the riparian corridors. After DOE purchase, grazing was stopped and the native plant communities were allowed to return with little or no management

Revegetation Planning Assumptions And Disclaimers

Initial planning for the D&D (Decontamination and Decommissioning) phase of the cleanup of the Site had permanent revegetation of the IA occurring at the end of the cleanup after all the buildings, structures, roads, and parking lots had been removed. After final grading and contouring, revegetation was to be done to return the Site to a more native state. This approach was changed when the first buildings were taken down (Spring 2002). At that point the decision was made to do final revegetation of project footprints as projects were completed (opportunistic revegetation approach). This approach has both positive and negative impacts on the final endstate of the IA. A positive outcome is that many of the smaller, isolated native areas that remain in the IA will be left untouched during cleanup. However, a result of an opportunistic revegetation approach to the revegetation of the IA is that different areas of the Site will be in varying states of succession for years to come, with many of these areas being quite small. This has the potential to increase maintenance and monitoring level of effort because each individual revegetation project (location) may have somewhat different needs. More recently (Fall 2003), lessons learned from some of the initial reseeding efforts have shown that it makes more sense to wait until larger areas are ready for reseeding, so that continued D&D operations don't constantly disturb the reseeded areas. Currently decisions are made on a project by project basis to determine whether to reseed with the final seed mix or use temporary reseeding and additional erosion control measures until the final reseeding can be applied.

While this Plan does contain specifications for wetland areas in the IA, any disturbance of jurisdictional wetland areas would require an approval by the U.S. Environmental Protection Agency (EPA) or U.S. Army Corps of Engineers (COE) that would address specifications for the wetlands, including reconstruction. Therefore any wetland revegetation must be reviewed by the K-H Ecology group and as necessary, the appropriate regulatory agency.

This Plan also does not address revegetation of soil covers which may have specific requirements for vegetation based on the purpose of the cover. The revegetation of soil covers will be designed specifically for each project and specified in the Rocky Flats Cleanup Agreement (RFCA) Decision Document.

Revegetation Techniques

Appendix B contains a color coded map of the IA (Figure 1). The shaded colored areas on the map correspond to specification sheets for the shaded colored area. The different colors represent the predominant plant communities in place prior to the construction of the IA. The blue areas were predominantly xeric tallgrass prairie. The red hillside areas would have been mesic mixed grassland and the brown areas would have been the drainage bottom areas. Specification sheets for each area are also included in Appendix B. The specification sheets contain basic instructions on seedbed preparation, seed mix, planting, and erosion control measures. These specification sheets are updated on occasion, therefore the most recent updates should be obtained from the K-H Ecology Group. Changes to any information provided on the specification sheets must be approved by the K-H Ecology Group.

The specifications provided in Appendix B also apply to revegetation projects in the Buffer Zone. However, due to the complexity of the landscapes in the Buffer Zone and regulatory/compliance issues in Preble's mouse habitat and wetland areas, the K-H Ecology Group should be contacted prior to initiation of any revegetation efforts in the Buffer Zone.

Soil Characterization

Soil characterization of several revegetation locations representative of general IA conditions was conducted during the summer of 2003. The soil sampling plan and results are presented in Appendix C. Of all the variables measured (Table 1, Appendix C), only the mean values for soil nitrogen levels fell below the guidance recommended by the Savage and Savage report (Savage and Savage, 2003). The Savage and Savage report suggested that if nitrogen levels were below 6 ppm, amendments may be warranted. The measured value from the mesic grassland type revegetation locations was 4.3 ppm (SD [standard deviation]= 2.7) and the xeric tallgrass prairie was 5.9 ppm (SD = 4.1). Although the mean values were slightly below the recommended levels, both grassland types fall within the recommended levels taking the SD into account. At this time no nitrogen amendments are planned for any of the revegetation areas because scientific evidence is mounting that suggests that the addition of nitrogen fosters weed growth at the expense of desired species. If chlorosis (yellowing of living plant material) is noticed in the plants at the revegetation locations, the issue of nitrogen additions will be revisited.

Revegetation Management

Management of the revegetation locations is critical to final success. Management measures may include such activities as weed control, reseeding areas as necessary, thinning vegetation through fire or other mechanical means, irrigation, relocating or eliminating undesirable wildlife species, incorporation of erosion control measures, and controlling or limiting anthropogenic activities within revegetated areas.

It is normal for any revegetation effort to go through an initial stage of annual weeds followed by the establishment and dominance of the desired perennial species. As a result, weed control is not always warranted. Species such as *Kochia scoparius*, *Salsola iberica*, *Helianthus annuus*, *Erodium cicutarium*, and various annual mustard species are often common at the Site during the first two or three years of a revegetation effort. These species are adapted to the early successional environmental conditions and will not substantially reduce the growth and development of the desired perennial species. The species can actually protect the developing perennial vegetation by creating shade, reducing wind velocities, and creating favorable moisture conditions. In addition, they are providing additional organic matter to the topsoil. So removal of these species is not typically warranted during the first two or three years of establishment. However, after this time, control of the annual species is desirable. For other noxious

weeds, control may be warranted. Control of other noxious weeds will be conducted as needed, using appropriate control methods under an IWMP approach for the specific problem species.

Reseeding will be conducted only after is it determined that the desired perennial vegetation is not progressing adequately towards the revegetation goals and success criteria. Two potential scenarios will trigger reseeding efforts. First, when bare areas greater than 500 square feet exist over the course of a single growing season, and second, if after four growing seasons, quantitative data show that the total vegetation cover is less than 75 percent of the success criteria.

Other possible management considerations such as the use of prescribed fire or irrigation could be implemented if desired. Currently, however, neither the use of prescribed fire or irrigation are planned.

Access to the revegetation areas should be restricted to provide the greatest opportunity for success of the revegetation effort. Access should be restricted through the use of fencing, signage, and education.

IA Revegetation Success Criteria

Success criteria and monitoring are a necessary component of a revegetation plan to evaluate the success of the revegetation efforts. Revegetation success will be judged according to criteria for species richness, species composition, and total ground cover. These criteria are important indicators of site conditions and stability. The following criteria will be used for establishing revegetation success for in the IA:

Quantitative grassland success criteria:

1. A minimum of 30% relative foliar cover of live desired species (seeded native species and/or non-seeded native species).
2. A minimum of 70% total ground cover comprised of litter cover, current year live vegetation basal cover, and rock cover.
3. A minimum of 50% of the seeded native species will be present at the revegetation site.
4. No single species will contribute >45% of the relative foliar cover (except in areas where dominance by a single species is appropriate for long term wildlife and habitat management objectives).

Noxious weeds:

Noxious weeds will be evaluated on a species specific basis and weed control will be employed as necessary using appropriate IWMP strategies to achieve the success criteria listed above.

Monitoring will be conducted annually at selected locations to help determine the need for management and maintenance activities. Success will be based on the results from data collection. Monitoring will be continued until success criteria have been achieved at the selected monitoring locations. For example, if severe weather (i.e., drought) prevented vegetation establishment, then monitoring would be extended.

IA Revegetation Monitoring Assumptions And Limitations

These assumptions and limitations are specified for monitoring that may take place in the IA. Revegetation monitoring will be conducted at selected locations in the IA to determine whether success criteria have been met. One of the challenges to monitoring revegetation success in the IA results from the fact that revegetation of the IA is not going to take place in one effort after all the buildings, other structures, and parking lots have been removed. Instead the plan is to revegetate each structure or parking lot footprint as they are removed or potentially as larger areas become available. The result of this opportunistic revegetation approach to revegetation of the IA is that there will be a patchwork of revegetation in various stages of succession that will need monitoring. One of the limitations is the fact that not every tiny revegetation patch will be able to be monitored in depth. Therefore the following approach has been developed. In the Buffer Zone, limited revegetation efforts are planned. Most of the Buffer Zone efforts will involve mitigation for either wetland and/or Preble's mouse issues and have specific monitoring requirements as specified in the appropriate regulatory documents.

IA Revegetation Monitoring Methodology

Revegetation monitoring will take a two-fold approach using both qualitative and quantitative monitoring. Qualitative monitoring will be used to monitor revegetation locations less than one acre in size. Qualitative monitoring will be conducted through the use of permanent photopoints and field notes. A minimum of two photopoints will be used to document each revegetation location. Photopoints will be visited at least annually during the summer. Additional photographs may be taken at other times if necessary. Both landscape and quadrat photographs may be used as appropriate. Field notes will be taken to note the status of the revegetation and any management needs. The Qualitative Revegetation Evaluation Form used to assess the revegetation locations can be found in Appendix D. These evaluations will be used to determine whether additional management actions are needed at these locations.

Quantitative monitoring will only be used to monitor revegetation locations that are larger than one acre in size. However, not all revegetation locations in the IA greater than one acre in size will be monitored. Quantitative monitoring will be conducted at selected locations in the IA. Each year until Site closure, ten additional 50-m transects will be randomly located in areas where revegetation has taken place the previous year. No pre-revegetation monitoring will be conducted since the areas will be bare ground. Transects will be randomly located each year. Monitoring will be conducted during the late summer or early fall (August-September) each year and will evaluate species richness and species cover.

Species richness will be determined in a 2-m-wide belt centered along the length of each 50-m transect. Every plant species rooted within the 100-m^2 area will be recorded. In addition, the numbers of any woody plant stems and cactus stems will be counted and recorded for the 100-m^2 area.

Basal cover and foliar cover will be estimated using a point-intercept method along each 50-m transect (Bonham 1989). A 2-m-long, 6-mm-diameter rod will be dropped vertically at 50-cm intervals along the transect to record a total of 100 intercept points. Two categories of hits will be recorded: basal and foliar. Basal cover hits are recorded based on what material was hit by the rod at the ground surface. Hits can be vegetation (live plants), litter (fallen dead material), rock (pebbles and cobbles greater than the rod diameter), bare ground, or water, in that order of priority based on the protection from erosion provided by each type of cover. Basal vegetation hits are recorded by species only if the rod is touching the stem or crown of the plant where the plant enters the ground. Foliar vegetation hits (defined as a portion of a plant touching the rod) are recorded by species in three categories as defined by height and growth form. The topmost hit of each growth form is recorded. The growth forms measured will include herbaceous, woody <2 m in height, and woody >2 m in height.

Data will be analyzed and summarized for each year for each revegetation location Species richness data will be summarized by generating an overall species list. Other species richness variables may be calculated from the species lists and used for comparison to previous years of data. Foliar cover data are reported as absolute cover, and relative cover for each species encountered. Absolute foliar cover is defined as the percentage of the number of hits on a species out of the total number of hits possible for each location. This value is the actual cover of a species. Relative foliar cover is defined as the number of hits a species had relative to the total number of vegetative hits recorded per location (i.e., the percent of total vegetative cover [100 percent] represented by the species). Other analyses that may be explored include a Shannon-Weaver diversity index that is used to calculate diversity and will be based on the relative foliar cover data (Brower and Zar 1977). A detrended correspondence analysis (DCA; PC-ORD 1999) ordination technique may also be used in the future once a few years of data have been collected. These analyses may be used to evaluate changes in vegetation over time for each location or to compare locations to one another or to native grassland areas at the Site.

References

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Brower and Zar. 1977. Field and Laboratory Methods for General Ecology. Wm. C. Brown Company Publishers, Dubuque, IA.

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Savage and Savage. 2003. Rocky Flats Environmental Technology Site Industrial Area Revegetation Plan. Prepared by Savage and Savage, Inc., Louisville, CO for Kaiser-Hill Company, LLC. January 2003.

SCS. 1980. Soil Survey of Golden Area, Colorado. U.S. Department of Agriculture, Soil Conservation Service.

APPENDIX A

Comment Responsiveness Summary
Rev. 2
January 2004

Comment Responsiveness Summary for the Savage & Savage Plan and Specification Sheets

Reviewer	Comment No.	Comment Description	Comment Resolution
CDPHE	General - 1	The report and associated documents are not a plan nor do they encompass the program required for successful restoration. Erosion control of disturbed lands is achieved through a combination of slope stabilization and revegetation. Slope stabilization will be achieved through the final land surface reconfiguration, which will define site slopes and drainages, and the site wide water balance, which will define post-closure surface water and groundwater conditions including areas of seeps. A site revegetation plan will specify what is required to reestablish a vegetative covering across the site capable of preventing erosion of the surface. Since this revegetation is required for the life of the contaminants (essentially, in perpetuity), the stability of the vegetation is necessary under a variety of conditions. The desired degree of stability is demonstrated by the natural vegetation in undisturbed areas of the site, and this natural condition becomes the goal of revegetation and restoration.	The information developed by Savage & Savage, Inc. has been used to develop the "Rocky Flats Environmental Technology Site Revegetation Plan. The revegetation plan will be incorporated into the Industrial Area (IA) Grading Plan. The combined document provides final Industrial Area grading, slope and revegetation requirements.
CDPHE	General - 2	A plan for the entire site's disturbed areas is not included. Restoration should address all disturbed areas across the site, such as the unused landfill, roadways and support facilities, and in particular those areas included in accelerated or remedial activities, such as the landfills, trenches, PU&D Yard and ponds.	While the revegetation plan and specification sheets were originally developed for the IA, they also apply to the Buffer Zone areas at the Site. Some specific projects may have a separate revegetation plan depending on the particular requirements of the project.
CDPHE	General - 3.	The plan needs to address final land configuration. The Map and four revegetation specification sheets provide more specific guidance for what vegetative cover will be used where. However, the map indicates truncated drainages from what used to exist in the pre-industrial condition of the pediment. Even with engineered and management controls, historic erosion patterns will work over time to reestablish the historic drainages, and the most effective long-term approach will be to mimic natural drainages.	The engineering of the drainages in the IA is beyond the scope of the revegetation plan. Contouring of drainages is addressed in the IA Grading Plan.
CDPHE	General - 3.	Seeps and the upland woodlands associated with the side slopes of the drainages are common now. Use of the modeling efforts for the	Seeps and upland woodlands associated with drainage side slopes will develop naturally over time or can be planted in

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		groundwater system post closure support such flows, but there is no consideration/differentiation of those areas or pertinent plant species considered.	the future if the managing agency deems it appropriate. Such plantings are beyond the intial scope of this plan.
CDPHE	General - 3.	The groundwater modeling effort indicates higher water tables after closure and predicts little stream flow in the drainages downstream of the IA. While seeps and alluvial flow in and adjacent to the IA are expected to increase, sustained stream flows are not, rendering the present pond system moot. Therefore, the restoration plan should be based on re-configuration within the drainages in both the IA and buffer zone.	The scope of the revegetation plan encompasses the actual revegetation specifications. The slope stabilization, final land reconfiguration, and other issues are addressed within the IA Grading Plan. Revegetation of the pond removal/reconfiguration areas will be dealt with in the specific regulatory documents (Section 7 consultation process for the Preble's mouse and/or other documents for wetland issues).
CDPHE	General - 4	Restoration needs to include habitat restoration requirements. The natural drainages adjacent to the IA in North Walnut Creek have been modified substantially with road and parking areas, which will serve no purpose after closure and should be removed. This historic modification fragments the streams and riparian habitat in areas listed as proposed critical habitat for a threatened species under the Threatened and Endangered Species Act, the Prebles Meadow Jumping Mouse (PMJM). The plan should provide for enhancement of the habitat and succession criteria for the individual plant species and recovery of the PMJM.	Any project activities impacting Preble's Meadow Jumping Mouse protection areas or proposed critical habitat are being addressed through the conferencing or Section 7 consultation process. Habitat enhancement and success criteria within the protection areas or proposed critical habitat are specified in conference documents, biological evaluations, or biological opinions issued by the United States Fish and Wildlife Service (USFWS).
CDPHE	General - 5	The plan needs to address a schedule for implementation. Additional specifications for revegetation are required to include a schedule for implementation and delineation of practices to be followed over time. Since these efforts will extend beyond closure, they become and important part of the implementation of the Long-Term Stewardship Strategy.	The revegetation plan addresses the activities that are to be conducted between now and closure. Post-closure management and monitoring are beyond the scope of the K-H contract with the Department Of Energy (DOE). Practices to be followed over time after the end of the contract are the responsibility of DOE and the USFWS to develop.
CDPHE	Specific -1	Why not provide some natural fertilizer, mulch or other attribute to support germination and initial growth as indicated in Section 4.1 of the Final Draft (especially if there is not going to be any additional water augmentation to help germination of the seeds)? Plant cover can be used as a natural mulch, by mixing annual vegetation with sterile seeds in with the native seeds. This cover temporarily stabilizes the soil, allowing native vegetation to take	Soil analysis results has shown no need to add soil amendments at this time.

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		hold, and in subsequent seasons, the dead plants serve as mulch.	
CDPHE	Specific - 2	Will there be a wind restriction for planting or broadcasting/spreading the seeds and mulch?	A wind restriction of 25 m.p.h. has been added to the specification sheets above which seeding/mulching activities may not take place.
CDPHE	Specific - 3	Since this is "rocky flats" there should be a recognition that pebbles and rocks should be expected on the surface, with often little real soil available for seed germination or planting. Without the rocks and pebbles the soil will be removed by the wind, as well as the water on slopes. As such, how will this effect the proposals to rip/scarify/disc the surface soil?	It is recognized that pebbles and rocks may be expected on the surface. The ripping is done to reduce deeper soil compaction and the discing is simply to break up any large dirt clods. These preparation techniques have not to date substantially reduced the rocks and pebbles present on the surface soil.
CDPHE	Specific - 4	The effectiveness of the revegetation process is dependent on the proper topsoil. Topsoil should match that in the undisturbed areas from a chemical standpoint, and needs to include natural microorganisms from healthy local topsoil. Sources of undisturbed local topsoil should be identified to inoculate revegetated areas. Natural areas to be disturbed could serve as seed areas for this soil. (Possibly, topsoil from the adjacent mined areas could be used) Stockpiling the soil destroys the microorganisms and should be avoided.	The IA Grading Plan identifies on-site borrow areas to be used. If imported topsoil is required, all efforts will be made to use local soils, such as from adjacent mining sites. Currently however, no imported topsoil for projects is planned unless there are specific project criteria that would require it.
CDPHE	Specific - 5	Will the gravel areas around the site be removed and used as fill as indicated in Section 4.2.2.1? These areas include the current and former security fence area and areas around several of the buildings and trailers where the ground is covered with several inches of gravel	In accordance with the IA Grading Plan, the referenced gravel areas will be used as fill or modified to support plant growth.
CDPHE	Specific - 6	Why are the seed mixes in the "Revegetation Specification Sheets" different from those in the Plan? If not included in the initial seeding, when will the other grasses, forbs, and shrubs be added? Vegetation for wetlands, riparian woodlands and upland shrublands needs to be included	The seed mixes in the spec sheets differ from those in the Savage and Savage plan for several reasons. A. Some of the species listed in the Savage & Savage Plan are not currently found at the Site. These species were removed since the revegetation objective is to plant species native to the Site. B. Some of the varieties have been changed because the local seed dealers do not sell the varieties specified in the Savage & Savage Plan. C. Forb species have not been included in the

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			specification sheets because of the potential need to apply herbicides for weed control at the revegetation locations. K-H has no plans to do any additional seeding to add other grasses, forbs, and shrubs beyond what is specified in the plan and specification sheets. The K-H goal is to seed back the dominant native plant species. Additional seeding of subdominant and rarer plant species can be done in the future if desired by the managing agencies. In the fall of 2003, some seed collections were made by volunteers at nearby locations. This collected seed will planted at some of the revegetation locations as locations are scheduled for reseeding. Wetland vegetation is specified in the drainage bottom area specification sheets. K-H does not plan to put in any upland shrubland communities since these typically occur around seep lines. The long-term managing agencies can do this at a later date if they so choose based on the locations where seeps ultimately daylight on the hillsides. They will also develop naturally themselves over time at these locations.
USFWS	Specific 1 2/20/03	It is recommended that native hay mulch be used after seeding. The native hay mulch must also be certified as weed and pest free, but it has been found at the Arsenal that the issues with weed propagules are not as prevalent with the native hay mulch as it is with straw mulch. The Arsenal has also found that it is somewhat comparable in cost, depending on the source.	The Site will continue to use straw mulch (winter wheat or oats) as it has in the past due to the potential to introduce exotic, perennial graminoid species such as smooth brome, intermediate wheatgrass, or crested wheatgrass.
USFWS	Specific 2 2/20/03	Soil amendments should be added if deficiencies are found during soil characterization. The first sentence in all of the “Soil Amendments” sections should be modified to concur with the “note” that follows the sentence.	A section has been added to the revegetation plan that addresses the results of the soil characterizations that were conducted.
USFWS	Specific 3 2/20/03	Ripping to two to three feet should be done, especially where the soil has been compacted. The Savage and Savage report	Changed ripping depth to 2 – 3 ft., as needed.

Reviewer	Comment No.	Comment Description	Comment Resolution
		recommends that ripping in compacted areas extend to three feet and to two feet if an area has not been compacted. If deep ripping is not done, rooting will be inhibited below the depth that ripping took place. Knowing the activities that are taking place in the industrial area, it is assumed most of the areas will be highly compacted by the heavy equipment, roads, and building slabs. Besides, this would be a great test to see if foundations and utilities are indeed covered by three feet of cover soil!	
USFWS	Specific 4 2/20/03	The Service still feels that initial irrigation is warranted to establish the vegetation. Even though the Savage and Savage report recommends no irrigation, the habitat management people from the Arsenal feel that if done properly (limiting water quantity and weaning the vegetation off the water in the late summer) it will enhance the success of the revegetation process.	Sentence added to Revegetation Management section that says irrigation may be used if desired. Currently, however, there are no plans to use irrigation.
USFWS	Specific 5 2/20/03	There is a lack of forbs in the seed mixes. There had been some previous discussions with Jody Nelson concerning inclusion of forbs in the seed mix and the ability to use herbicides to control weeds. However, since the soil will be characterized and amended only as necessary (rather than importing topsoil), there is less concern about having to control large amounts of weeds. Therefore, the Service recommends that the forbs should be added back into the seed mix, as recommended by the Savage and Savage report.	Forbs were added to Rev. 1 of the revegetation plan, however, based on later discussions with the USFWS during a tour of the revegetation locations in fall 2003, forbs have been removed from the seed mixes because potential herbicide applications will likely kill them. Instead it makes more sense to seed in the forbs at a future time when the native graminoid species have established and are providing good competition for the weedy species. The forbs can be inter-seeded in the future.
USFWS	Specific 6 2/20/03	Three major issues that were covered in the Savage and Savage report are not covered in the specification sheets. The decision not to include them may have to due with the way Kaiser-Hill is planning on subcontracting the revegetation process, however, they need to be addressed somewhere. Those issues include revegetation management, revegetation monitoring, and success determination. Once the seed is in the ground and the mulch is applied, the job is not done. The revegetated areas need to be managed and monitored, and ultimately the revegetation needs to be deemed successful. Does Kaiser-Hill have a plan of where these issues will be addressed? The Service recommends that the subcontractor that is responsible for revegetation also be responsible for management	Revegetation management, revegetation monitoring, and success criteria have been added to the revegetation plan. The responsibility of conducting the management, monitoring, and success criteria will remain K-H until the end of their contract with DOE. At that point it will transfer to the long-term managing agencies at the Site.

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		and monitoring of the sites and that Kaiser-Hill and ultimately DOE be responsible for success determination. However, this all needs to be spelled out before the process begins.	
USFWS	General 1 8/27/03	It is assumed that this document does not include the revegetation of the landfills or other areas that have been or will be disturbed (e.g., trench areas, ponds, PU&D yard). If it does, then further discussion is needed.	This is generally true, although the basic seed mixes could be applied to other areas with perhaps some modifications for particular needs. For projects with separate decision documents, seed mixes will be provided to the project which meet specific project needs.
USFWS	General 2 8/27/03	The plan should be revised with revegetation limited to plots of 10 to 30 acres at a time or larger. Smaller plots will be more expensive to revegetate and much harder to monitor. Smaller plots will end up with distinct field lines around the edges, which might not look natural on the ground.	K-H project management has decided that in general projects will be revegetated as the areas become available. However, where possible and due to continuing D&D surrounding some locations, the revegetation of some smaller areas is being held off until larger areas are available.
USFWS	General 3 8/27/03	Success criteria are fine, but, who will be determining the success after the site is closed? The Service is concerned that once K-H concludes the cleanup contract, that there will be no accountability for the success of the revegetation. DOE may want K-H to post a bond or withhold final payments until at least 5 years after final seeding has taken place to make sure that the revegetation is a success on the site. One or two years of monitoring will not determine whether the reseeding was a success. If K-H is not held accountable, DOE and the Office of Legacy Management must be ready to take on the responsibility of ensuring success of revegetation. The Service reminds DOE that the IA must be suitable habitat for inclusion in any overlay national wildlife refuge.	K-H's position on this is that it will be the responsibility of the long-term land steward to continue the monitoring and conduct any post-closure management of these areas. Thus that is up to DOE and the USFWS.
USFWS	General 4 8/27/03	This plan does not have a contingency for failure of revegetation. Such contingency should be added.	Reseeding of areas is addressed in the section entitled Revegetation Management. It mentions that where bare areas greater than 500 sq. ft. exist over the course of a single growing season or when after four growing seasons total vegetation cover is less than 75 percent of the success criteria, these situations would trigger reseeding.
USFWS	General 5 8/27/03	The specifications are vague and would be difficult to bid or quality control.	The seed mix specifications are very detailed as to what is to be ordered on a per acre basis. Each specific project will have to determine its own needs based on the location and size of the revegetation effort. It is not possible to include

Reviewer	Comment No.	Comment Description	Comment Resolution
			such detail and have it be meaningful in a document such as this. The revegetation plan outlines the issues to be taken into consideration that can be used to develop bids for specific projects.
USFWS	Specific 1 8/27/03	Page 1, Goals and Objectives - It is unfortunate that the goals and objectives only include revegetation and not restoration. The Service would like DOE and K-H to reconsider this and look at the landscape holistically and move more towards restoration.	The Site's revegetation plan was written to provide projects at the Site the information they need to revegetate their projects using appropriate seed mixes and specifications. The plan was designed to be used through closure with the perspective that nothing that will be done would preclude the long-term stewards from conducting full scale restoration efforts if they so desired. The plan was never designed to be an exhaustive, long-term restoration plan. If the long-term land stewards wish to conduct a full scale restoration of the IA, it would make sense that they should develop that plan themselves so that it incorporates their goals and objectives since K-H will not be involved at that time. That is beyond the scope of the K-H contract. The species being planted during Site closure will not preclude future full-scale restoration activities..
USFWS	Specific 2 8/27/03	Page 2, second paragraph – *Bromus japonicus* is an exotic species and should not be included in the current native species list for the mesic mixed grassland.	This paragraph is describing the common species found on the mesic mixed grasslands at the Site. It is not a listing of those species that are intended to be planted. K-H has no intention of planting *Bromus japonicus* or any other exotic weed species.
USFWS	Specific 3 8/27/03	Page 2, Revegetation Planning Assumptions and Disclaimers – The assumption that different areas of the site will be in varying sites of succession for years to come is probably a true assumption. But this piecemeal approach to the work will also result in higher costs and greater difficulty for future management. Tougher to control weeds, monitor success, etc. for years to come. With such small patch sizes, it is safe to assume that even where revegetation is successful, the patches will be too small to be good habitat.	The fact that different areas of the overall revegetation areas will be in different states of succession is not argued. However, in nature, natural and anthropogenic disturbances create a patchwork of varying states of succession on the landscape as well. The native landscape in the Buffer Zone at the Site is not one large continuous uniform plant community. Instead there is a lot of variation in species abundance from one area to another on the prairies at the Site. The wildlife seem to be quite adapted to the natural patchwork in the Buffer Zone. Thus if the revegetation patches are successfully revegetated in the long-term, why

Reviewer	Comment No.	Comment Description	Comment Resolution
			would the overall area not be good habitat since they would provide a patchwork like that of the surrounding landscape? A long-term perspective is necessary for the revegetation efforts at the Site. The successful revegetation of the IA and other areas at the Site will not be accomplished in a couple of years – perhaps a couple decades! So it ultimately will fall to the long-term land managers at the Site to decide what sorts of management practices they want to use to create the type of habitat they want. K-H is only starting this process which will then be built upon by the future resource stewards.
USFWS	Specific 4 8/27/03	Page 3, Revegetation Techniques, second paragraph – The Service agrees with the strategy of only using soil amendments if needed. Finding weed-free soil amendments seems to be a bit challenging. Only use amendments if absolutely necessary, unless there is confidence in the supplier to provide weed-free amendments. If amendments are being considered, they should be included in the plan.	No soil amendments are currently planned for use. However, their use will be evaluated on a project by project basis.
USFWS	Specific 5 8/27/03	Page 3, Revegetation Management, second paragraph – The statement that tall successional weed species will not substantially reduce the growth and development of the desired species, is misleading. They will affect the establishment of the perennials unless they are subdued somehow – they compete for sunlight, moisture, and nutrients right along with the new grass seedlings. Typically this can be accomplished by mowing them down to about a 1 – 1 ½ foot height, particularly the first year of the stand. This will also keep them from producing seed heads. Even at that height, the residual weeds will still help trap snow, provide organic matter, reduce wind velocities, etc.	The sentence was removed. Mowing is an optional management tool and may be used at some locations as appropriate.
USFWS	Specific 6 8/27/03	Page 3, Revegetation Management, fourth paragraph – The Service continues to recommend the appropriate use of irrigation to establish the stands of native species.	Irrigation while an option, is not currently planned for the revegetation of the IA. Additionally, once water to the Site is shut off, it will not be an option.
USFWS	Specific 7	Page 4, IA Revegetation Success Criteria, last paragraph – The	Through contract completion or transfer of contract

Reviewer	Comment No.	Comment Description	Comment Resolution
	8/27/03	Service agrees that monitoring should be conducted annually. Who will be responsible for monitoring? If it will be the Office of Legacy Management (OLM), they should be brought in now to start monitoring previously revegetated areas.	responsibility, the K-H will be responsible for monitoring activities. Post-closure, it will be up to the long-term land steward to decide who will conduct the monitoring. DOE will need to involve the OLM when they believe it is appropriate.
USFWS	Specific 8 8/27/03	Page 4, IA Revegetation Monitoring Assumptions and Limitations – See general comment number 2. Where are the areas to be monitored? The locations should be identified upfront, before the revegetation begins.	The revegetation plan discusses monitoring. With respect to identifying monitoring locations it would be difficult to identify locations up front before revegetation begins since project schedules are constantly changing and so it is not possible to know when or exactly what areas will be ready for revegetation. Instead we have taken the approach to begin monitoring as the locations become available each year.
USFWS	Specific 9 8/27/03	Page 4, IA Revegetation Monitoring and Methodology, paragraph 1 – Who will be visiting the photo-points annually? Will the photo-points be visited the same part of the summer each year? Will they be done at the same time that the qualitative analysis is done on larger parcels? Again, if OLM will be performing the monitoring, they should start as soon as possible, and visit all the parcels the same time of year each year.	K-H Ecology will conduct the photo monitoring through closure. The plan is to visit the locations for the photos at approximately the same time so that photo comparisons have as little time variability as possible. Photos of the transects themselves will be taken when the transects are sampled, which will be approximately the same time of year. After closure the long-term land steward will have to decide how things will be done. That is beyond the scope of the K-H contract.
USFWS	Specific 10 8/27/03	Page 4, IA Revegetation Monitoring and Methodology, paragraph 2 – Some consideration should be given to foliar vegetation cover, not only basal cover. This data will be collected as described in the methodology section. Replace “current year live vegetation basal cover” with “current year live vegetation basal and foliar cover”. Foliar cover is an important component of many erosion prediction models and other models predicting cap/cover function. In addition, if only basal cover is counted, many years may fail the 70% total cover criteria.	The plan currently states that both foliar and basal vegetation cover are measured along the quantitative transects (section entitled IA Revegetation Monitoring Methodology, paragraph 4). The 70% total cover criteria mentioned includes not only basal vegetation cover, but also litter and rock cover as well. It is a combination of all three cover types that must add up to 70%. These three ground cover factors identify how much protection the ground surface has. These criteria were taken directly from the USFWS revegetation plan for the RMA.
USFWS	Specific 11 8/27/03	Page 4, IA Revegetation Monitoring and Methodology, paragraph 2 – There may not be an advantage that supports the establishment of permanently marked transects since it is virtually impossible to	We have changed the approach to locate the transects randomly each year.

Reviewer	Comment No.	Comment Description	Comment Resolution
		recollect data at the same points along the transect. The effort to relocate previously established transects may not be justified. Is more important to better characterize the entire area with randomly established transects at each new data collection effort.	
USFWS	Specific 12 8/27/03	Page 4, IA Revegetation Monitoring and Methodology, paragraph 2 – The methodology calls for monitoring each year until site closure. Depending on when this plan is finalized, that may only be one or two years of monitoring. Monitoring will need to be conducted for a minimum of five years and possibly until the IA meets the conditions of free release. DOE needs to include this fact in the future budget of OLM.	As previously stated, K-H Ecology will conduct the monitoring through Site closure. Post-closure monitoring is a decision the long-term land steward will have to decide. That is beyond the scope of the K-H contract.
USFWS	Specific 13 8/27/03	Page 5 - The two paragraphs on this page seem to describe methodology somewhat disconnected from the objective of providing data for judgment against the success criteria. Although the information collected will be useful for an ecological understanding of the site and may help in management decisions, data such as species richness and diversity index and exercises such as "comparison to previous years" and "evaluate changes in vegetation over time" are not necessary for determining whether success criteria have been met. But it is important information to have.	The first paragraph is a continuation of that from page 4. It describes specifically how the modified point intercept method is conducted. Your point on the data analysis is correct. The data that are collected are what is required to assess the success criteria, but the additional analyses are also important to evaluate how the revegetation effort is progressing ecologically. This information can be used to modify techniques or to make management decisions. These data analyses and summaries can provide important information for the long-term ecological evaluation of the revegetation areas and for comparison to baseline information available on the native plant communities at the Site. .
USFWS	Specific 14 8/27/03	Specifications, Seed Mix – The Service would like to see 5% of the mix as forbs, it is currently only 3%. It would help to throw scarlet globemallow (*Sphaeralcea coccinea*) into the forb mix to bump it up to 5%. It's a great transitional species, liking disturbed sites, and is pretty drought hardy. However, consider as an alternative not to include forbs in the mix. Withholding forb seeds in the mix would allow treatment of certain weeds with herbicide which will surely come once the ground is disturbed and seeded. With just grasses, you could use a broadleaf herbicide like 2,4-D amine (2-4	The forbs have been removed from the seed mixes altogether because of the likelihood of conducting weed control in these areas. It is not worth the expense to put the forbs in the mix, only to kill them with herbicide applications. They can be inter-seeded at some point in the future if the long-term land manager decides to do so.

Reviewer	Comment No.	Comment Description	Comment Resolution
		pints/acre) with some Transline (for thistle and knapweed) to control it once the new grass has gotten to the appropriate leaf stage for spraying. The Arsenal has used this strategy and it has made a huge difference, they haven't had to mow weeds since they put the herbicide down, and the grass responded beautifully once the broadleaved competition was eliminated. Once the grasses are established and the weeds are under control, you can go back and put in the recommended forbs.	
USFWS	Specific 15 8/27/03	Specifications, Seed Mix, Drainage Bottom – *Amorpha fruticosa* is mislabeled; it is actually false indigo, which is suited to wetter sites. Leadplant (*Amorpha canescens*) is an upland species more suited to drier regimes and is the plant that is recommended. Please make the correction.	*Amorpha fruticosa* is the correct species. It occurs commonly along the streams at the Site and was selected for that reason for the wetter area seed mix. In this region, it is commonly referred to as leadplant. We will change the common name to false indigo to avoid confusion. *Amorpha canescens* does not occur natively at the Site.
USFWS	Specific 16 8/27/03	Specifications, Seed Mix, Temporary Seed Mix – The Service suggests to add Sideoats grama. It's drought-resistant, is a warm-season species, establishes well, and would make a nice warm-season component in the temporary seed mix. Right now, the temporary seed mix consists of all cool-season species. Adding a warm-season species increases the chances for something else working out there. Sideoats grama is now being recommended as a "bridge" species in seed mixes, so sideoats is a good temporary/transitional species.	Side-oats grama has replaced the thickspike wheatgrass that was previously included in the temporary seed mix.
USFWS	Specific 17 8/27/03	Specifications, Seed Application, Timing – a) June 15 may be a little late, even for warm-season seeds. It's definitely too late for cool-season seeds. It may help to back off the date to June 1st through 5th. If irrigation is not being used, May 15 is a better end date for spring seeding. b) The August 15 to November 15 window – There are really two categories of seeding in that fall window. If the existing specifications mean they can seed any time	These dates were recommended in the Savage and Savage draft revegetation plan for the Site. We have found, however, that in several cases seedings done outside these windows have produced the best results. We have therefore removed the seeding windows from the specifications and added language stating, "Although no seeding windows are specified, greater success may be achieved when seeding is done in late fall, winter, or early spring."

Reviewer	Comment No.	Comment Description	Comment Resolution
		August 15 – November 15, then there may be some problems: (1) Late summer seeding, August 15 - September 1: It is possible to do a late summer seeding, sometimes with spectacular results, but you are gambling on getting late summer moisture. The strategy of a late summer seeding is to get plants established before the coming winter so they can establish quickly the coming spring. This is the same strategy used by farmers for planting winter wheat. (2) A dormant seeding, from mid-October to November 15: the strategy here is to seed at a late enough time where the seed has no chance of germinating before winter. If you seed from that mid-September period to mid-October period, you risk the possibility that your seed will still germinate, and if it does, it will not have enough time to attain any size and will winterkill. This is probably more critical with cool-season grasses than warm-season grasses; cool-season grasses will germinate a much cooler temperatures, whereas warm-season grasses need 50 degree soil temperature to germinate. However, if you seed late enough in the fall, dormant seedings work great, particularly with cool-season species, because they become subject to Mother Nature's natural stratification regime and will germinate when the temperature and moisture is right for them. There are cases where land managers broadcast their seed in the snow with good results, (the seed melts into the snow) so even the November 15th date might be a bit constraining so long as the soil is not frozen by then. Not knowing the range of soil temperatures, we would	

Reviewer	Comment No.	Comment Description	Comment Resolution
		leave it up to the ecology group to determine how feasible it is to seed from mid-September to mid-October, and what they think the chances of seed germinating prematurely might be.	
USFWS	Specific 18 8/27/03	Specifications, Seed Application, Wind speed – Knowing that Rocky Flats is a windy site, this may not be practical, but a 25 mph wind is a pretty stiff breeze. It is hard to conceive applying mulch or broadcasting seed in wind conditions like that, particularly with buffalograss, switchgrass, blue gramma, sideoats, and other native species, which have very light seeds. It is doubtful that you would get even coverage over the site broadcasting in a 25 mph wind. It is possible that the contractor is experienced at working at these wind conditions, but the Service would lean more to an upper limit of 15 mph if at all possible.	We changed the wind speed to 20mph.
USFWS	Specific 19 8/27/03	Specifications, Mulch Application, Rate of mulching – Whether or not to go with 1.5 tons/ac or 2 tons/ac remains a controversy. In looking at a site, it is surprising the difference in surface coverage an extra half ton per acre can make on the ground. This may be due to the fact that in practice, a two ton/ac rate is a lot more difficult to spread evenly than 1 ½ tons/ac. With species like blue gramma and buffalograss, you may not want to use two tons/ac of mulch – it seems to be applied too dense, and these species will have trouble germinating through it. If the mulch does not stay crimped, it will blow into "hay-drifts", which will cause more shading problems. The Service would recommend looking into using 1 ½ tons/ac.	It has been changed to 1.5 tons/acre.
USFWS	Specific 20 8/27/03	Specifications, Mulch Application – Mulch should be described as "native grass hay" and references to "straw" should be replaced with native grass hay.	We are using straw mulch and specifying that it be either winter wheat or oats. The concern with using "native" hay is that a "native" hayfield may be composed of smooth brome, intermediate wheatgrass, or several aggressive, exotic graminoid species. We don't want to introduce more of these.
USFWS	Specific 21 8/27/03	Specifications, Seed rate – Doubling seed rate for broadcast seeding is not mandatory, if the seed is not covered more deeply than 0.5	We will take your comments under consideration. Given that we are not irrigating, the higher seeding rates have given

Reviewer	Comment No.	Comment Description	Comment Resolution
		inches as described. Also, consideration should be given to lower rates, e.g. 35 seeds per square foot. Both of these will have to be proven in the field.	us good results at the Site.
Paul Kilburn	Comment 1 7/23/03	First the stated goal of the plan is **revegetation**, and not **restoration** to original conditions. We think the stated goal should be **restoration**, which although perhaps a more difficult goal, it is certainly a worthy one. The upland areas were originally xeric tallgrass prairie on the Rocky Flats Alluvial Surface and the species list is only partially correct. In the *Five-Year Study of the Ecology of Bluestem-dominated Grasslands of the Rocky Flats Area, 1996-2001,* by ESCO Associates, the following species dominate Section 16 just west of the Technology Site. These dominants include the following **grasses**. (Those asterisked are on the seed list utilized in the Revegetation Plan): *Big bluestem *Andropogon gerardii* *Little bluestem *Schizachyrium scoparium* Mountain muhly *Muhlenbergia montana* *Hairy grama *Chondrosum hirsutum* *Side oats grama *Bouteloua curtipendula* *Indian grass *Sorghastrum nutans* *Prairie junegrass *Koeleria macrantha* Sun sedge *Carex pensylvanica ssp. heliophila* And the following **forbs**: Porter's aster *Aster porteri* *Blanket flower *Gaillardia aristata* Golden aster *Heterotheca fulcrata* *Blazing star or gayfeather *Liatris punctata* Fendler's senecio *Senecio integerrimus* Scurf pea *Psoralidium tenuiflora* Prairie clovers *Dalea candida and D. purpurea*	There is nothing in the Revegetation Plan that precludes the long-term steward at the Site from initiating a complete restoration program for the IA if they so desire. K-H plans to use common native plant species found in the plant communities at the Site to establish a vegetative cover to protect the soil and prevent erosion. Additional species can be interseeded later if so desired to do a more complete restoration. Also, some of the plant species listed in the letter are not available commercially. These include mountain muhly, sun sedge, Porter's aster, and nailwort. This does not include the 200+ other species that have been documented on the grasslands at the Site. The vast majority of these are also not available commercially. Therefore while it is a noble desire to want to restore the native prairie, it is not feasible to do so given the current state of available seed material. (Seed collection is discussed below.) It is also not desirable to plant all the species initially, especially the forb species, because in the early stages of revegetation it may be necessary to apply herbicides to control noxious weeds. If that becomes necessary the compounds used would most likely kill the seeded forbs as well as the noxious weeds. Therefore it would make more sense to wait and interseed these species after the seeded graminoid species have become established. A final comment related to a restoration of the native prairie community at Rocky Flats or anywhere else along the Front Range is that no one has ever completed a true restoration of a native prairie. To some extent this depends on how the

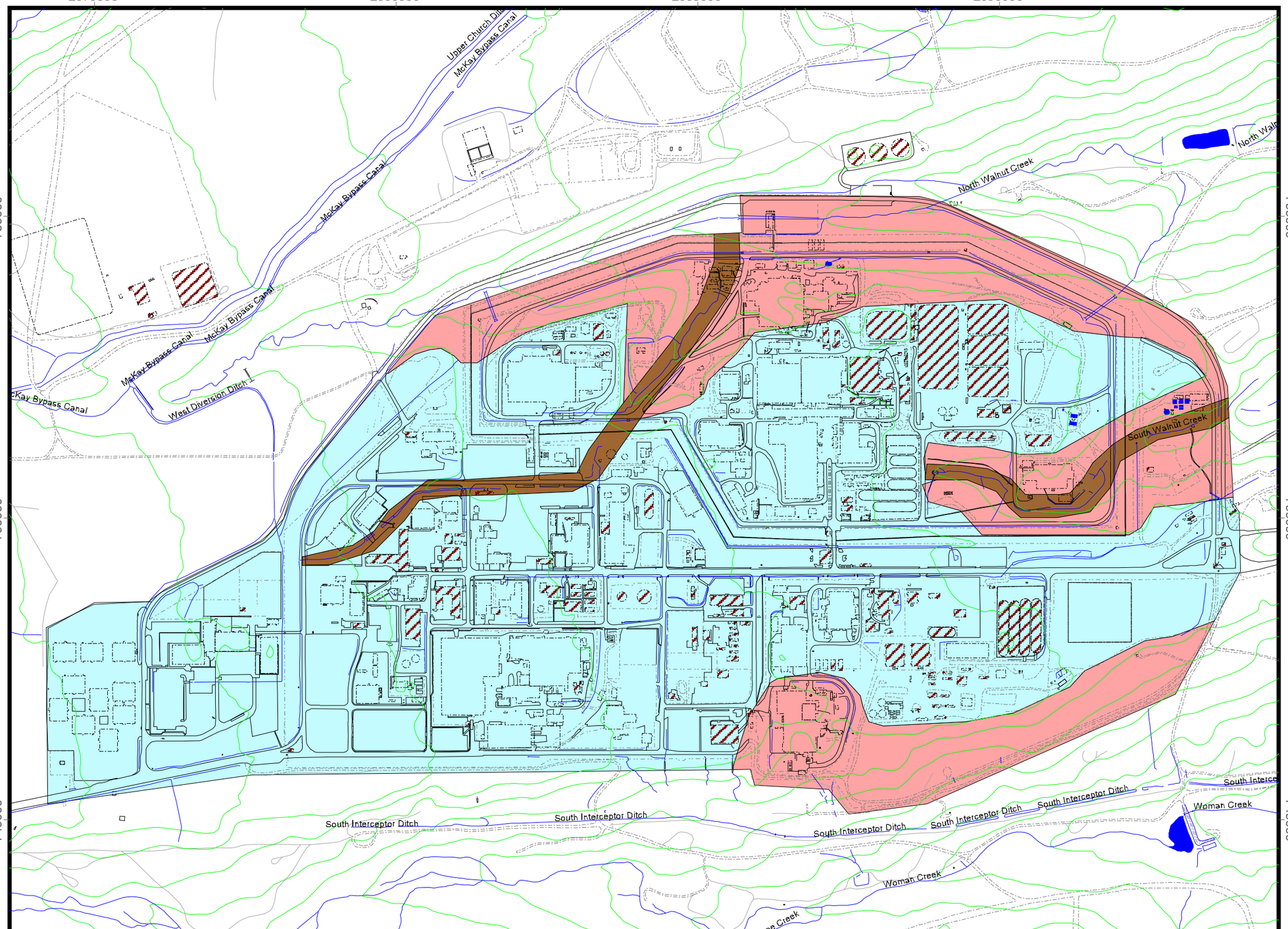
Reviewer	Comment No.	Comment Description	Comment Resolution
		Nailwort *Paronychia jamesii* The restoration goal for the upland areas should include all the above listed species with the goal of achieving a quantitative approximation much like Section 16, although the final species mix should be adjusted to the soils now present on site. The soils near Hiway #93 or cobbly and coarse. Inasmuch as the soils become more clayey and reflect the shallower surface gravels as one moves east the wheat grasses and needle grasses become more prominent. The final mix of species should reflect the soils present and wheatgrasses and needlegrasses may be an appropriate part of the mix under those circumstances. On coarser soils we would suggest use of the planting list on pp 33-34 of . of *The North Jeffco Plains: Source Book for Development with Conservation, 2002,* by Rick Brune et al., as it essentially provides a list which coincides with the ESCO study on the better drained soils.	final state of the prairie is defined, but the longest running restoration effort in N.A. is at the University of Wisconsin in Madison where a native tallgrass prairie restoration has been ongoing since the early 1940's. As of recent years, the prairie still does not contain all the species that an undisturbed native tallgrass prairie would have. Additionally, changes to the soil structure in the IA, are not going to be like pre-disturbance conditions, so it is unlikely that a full restoration of the xeric tallgrass prairie is possible. So to reiterate the first statement, there is nothing that precludes the long-term steward of the Site from initiating a restoration program of sorts for the IA if they so desire, but that is not the intention or goal of K-H.
Paul Kilburn	Comment 2 7/23/03	Seed source is highly important to the genetic integrity of the plantings and perhaps to their long term success. We are well aware of the importance of the use of local seed and we urge the DOE to use great care in seed selection from sources as near the site as possible. Seed sources from the eastern slope of Colorado are preferred to those from Kansas, while best of all are seed from Jefferson County. In this regard we would suggest, and we will be glad to help organize, a local seed collection on the Buffer Zone and surrounding open space areas to the west. A great deal of such weed-free and pure seed could be readily collected over the growing season and utilized to supplement, or even replace, purchased seed.	The issue of using locally adapted genotypes or ecotypes is a hot topic in the revegetation/restoration circles these days. Unfortunately while it may be sound theoretically, from a practical standpoint, its application in real life is rarely met. Local ecotypes of the native grass species are not available commercially and thus given the timeframe and quantities of seed necessary to reseed the IA, K-H will be using the commercially available material. Several factors listed below preclude the use of locally collected seed for the revegetation of the IA and other areas at the Site: 1. Regarding seed collection, the quantities of seed needed

Reviewer	Comment No.	Comment Description	Comment Resolution
			for the revegetation of the Site are not likely to be able to be collected by any practical means within the vicinity of the Site. Large-scale collection of native graminoid species from the Site or nearby Open Space lands is not practical for several reasons. 2. The seed needed to revegetate the Site is needed now or within the next two years. Therefore it is not feasible to collect seed and have it grown commercially to produce the quantities needed. 3. Annual seed production by the native species is variable from year to year based on local environmental conditions. Given the revegetation timeframe it is not practical to rely on chance and hope that enough seed might be produced naturally so it could be collected. 4. There is also the question of how viable the native seed would be once it was collected. The collection of several hundred pounds of seed that has little viability would not yield success in the revegetation areas. 5. Most areas at the Site and on nearby Open Space areas are infested by several species of noxious weeds. Any large scale mechanical seed collection would simply collect and plant the noxious weeds in the revegetation areas. Hand collection would yield more pure seed, but is unlikely to meet the quantities needed for the IA revegetation needs (see volunteer seed collection comments below). 6. During fall 2003, volunteers hand-collected several grocery bags of seed from nearby Open Space lands. K-H is willing to use this seed in the revegetation efforts at the Site recognizing, however, that it will continue to purchase commercially available seed for most of the seeding efforts.

Reviewer	Comment No.	Comment Description	Comment Resolution
Paul Kilburn	Comment 3 7/23/03	Technical assistance on the matters of seed collection, storage and planting can be obtained from The Morton Arboretum, Lisle, IL, which has established a large tallgrass prairie there; and the work of Dr. Robert Betz, who has established several thousand acres of tallgrass prairie at the Fermi Lab in Batavia, IL	We will take your comment into consideration.
Paul Kilburn	Comment 4 7/23/03	Shrubs should be planted in areas that were likely shrublands before overgrazing. These are some of the best wildlife areas and small container shrubs should be used in appropriate ecological situations. Shrubs to be utilized include hawthorn (Crataegus erythropoda), mtn mahogany (Cercocarpus montanus), wild plum (Prunus americana), chokecherry (P. virginiana), fragrant sumac (Rhus trilobata), and squawbush currant (Ribes cereum. There are others that could be added to the list such as juneberry and three species of snowberry. All are available from Rocky Mountain Native Plants Company in Rifle, CO.	Most of the IA was grassland prior to disturbance and would not have had the shrubs listed in this paragraph growing there. The shrub species listed in the letter only occur at the Site above the large hillside seep wetlands and sometimes along the streams. So these species would not occur on the upland grasslands and thus are not included in our seed mixes. For the few bottomland areas that may be in the IA, the amounts of water that might be available to support their growth is unknown and therefore most shrubs species were left out. They could always be added at a later date if water is available for their growth or where seeps eventually daylight on the hillsides. However, based on previous shrub planting efforts at the Site, to plant them without knowing that water is available for their growth and without the ability to irrigate, would be fruitless endeavor.
Paul Kilburn	Comment 5 7/23/03	The use of hay mulch could be excellent, if weed free local native xeric tallgrass hay is used. If not native hay could provide exotic and unwanted seeds added to the planting mix. We would recommend native xeric hay, and if unavailable, the most weed free straw available.	The Site will continue to use straw mulch (winter wheat or oats) as it has in the past due to the potential to introduce exotic, perennial graminoid species such as smooth brome, intermediate wheatgrass, or crested wheatgrass.
Paul Kilburn	Comment 6 7/23/03	Native vegetation establishment and stability is a long term proposition and should be a stated goal of this report. We expect such stability may not be achieved for twenty or more years, and the monitoring program should be planned to continue for at least this long.	A long-term perspective is necessary for the re-establishment of a native grassland. However, due to the contractual requirements of the K-H contract with DOE, the long-term objectives, management, and monitoring issues are beyond K-H's scope of work. Therefore the long-term steward at the Site will have to decide what their objectives are and how they want to manage and monitor the areas.

APPENDIX B

Revegetation Specification Sheets and IA Revegetation Map Rev. 2 January 2004



Industrial Area Revegetation Specification Sheet Map

Figure 1

LEGEND

- Flat Areas (Blue Spec Sheet)
- Hillside Slope Areas (Red Spec Sheet)
- Drainage Bottom Area (Brown Spec Sheet)

Standard Features

- Buildings
- Demolished Buildings
- Lakes & ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Trails
- Contours (20 ft. intervals)

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95.

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500 0 500 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: LABAT LABAT-ANDERSON INCORPORATED

For: Kaiser-Hill Company, LLC

RFETS GIS Dept. 303-966-7707

MAP ID: 02-0003

April 4, 2003

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Blue Map Areas

Flat Areas (Areas On Pediment Tops* With Slopes Less Than 10%) Revegetation Specification Sheet

This Revegetation Specification Sheet Supercedes All Previous Revegetation Information For RFETS
Date: 1/04

Seedbed Preparation:

1. No imported topsoil will be used.
2. Soil surface is to be ripped or scarified to a depth of 2 –3 feet to relieve soil compaction, as needed.
3. Soil surface is to be disced to reduce soil particle size and get rid of larger clods, as needed.

Seed Mix:

1. Purchase attached seed mixture for the total number of acres to be reseeded. The values in the far right hand column are the amounts per acre to be used when drill seeding. Be sure to order the correct variety of seed. NOTE: For broadcast seeding, double the amounts shown in the far right hand column.
2. The seed is to be ordered as pure live seed (PLS).
3. The seed must be certified weed free.
4. Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species). This allows Site ecologists to examine the seed for purity prior to seeding.
5. Pull the seed bag tags off the bags and provide them to the K-H Ecology Group.

Seed Application:

1. Although no seeding windows are specified, greater success may be achieved when seeding is done in late fall, winter, or early spring.
2. The seed can be drill seeded or broadcast seeded over the disturbed areas. Make sure to use the correct amount of seed for the application method chosen.
3. For broadcast seeding, handseeding or mechanical seeders such as a centrifugal, fan, airblast, or hydroseeder are to be used to distribute the seed. After broadcasting, the area is to be drag-chained or raked to cover the seed slightly and provide better seed/soil contact. Broadcasting may be more appropriate on the steeper slopes for safety concerns.
4. Drill seeding is best used on the flat or shallow slope areas. For drill seeding, the seeding depth is to be between 0.25 inches and 0.5 inches. Because the Site is prone to high winds, drill seeding is to be done using two passes, with the applications being perpendicular to each other and 45 degrees offset from the predominant wind direction. Seeding should not be done when wind speeds are greater than 20 mph.
5. Seeding will be done prior to any mulch applications.

Soil Amendments:

No soil amendments will be added without approval of K-H Ecology Group.

Mulch Application:

For flat areas (<10% slope) either crimped straw or hydromulch may be used for erosion control. For larger areas, crimped straw is more appropriate and less expensive, whereas for smaller areas hydromulch may be more applicable because of equipment constraints. Follow the guidelines listed below:

Crimped Straw

1. Straw mulch is to be spread evenly across the revegetated area after seeding (drilled or broadcast) has been completed. It is to be applied at a rate of 1.5 tons per acre. NOTE: The straw must be certified as weed and pest free according to the Colorado Weed Free Forage Act. It should be either winter wheat or oats and not have an abundance of seed heads present in the straw.
2. The straw is to then be crimped into the soil to prevent it from blowing away. If crimping is not feasible, then after the straw has been blown onto the seeded surface it is to be covered with a chemical tackifier following the manufacturers recommended application rate. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. Tackifier is to be applied at the manufacturer recommended rate per acre.

Hydromulch

1. Acceptable hydromulches include inert wood and plant fiber products (cellulose). Only tackifiers based on vegetable-based binders are acceptable at the Site to prevent undesired chemicals from leaching into the groundwater. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. The product known by the brand name "SoilGuard®" was also found to be chemically acceptable.

2. Hydromulch and tackifier are to be applied at the manufacturer recommended rates per acre.
3. Application of seed within hydromulch is not an accepted practice at the Site. Therefore areas are to be seeded (drilled or broadcast) prior to the hydromulch application. The hydromulch is to be applied with a tackifying agent to help prevent further erosion.

* The pediment tops are the upper flat surface areas throughout the IA.

For questions or more information regarding this spec sheet or if variances from these specifications are required contact the K-H Ecology Group at x2231, x3560, or x3687.

Flat Areas (Areas On Pediment Tops* With Slopes Less Than 10%) Revegetation Seed Mix **Blue Map Areas**
(Based on 50 seeds/sq.ft.)

This Revegetation Specification Sheet Supercedes All Previous Revegetation Information For RFETS
Date: 1/04

Scientific Name	Common Name	Variety	% of Seed Mix	# Seeds Needed	# Seeds/Lb.	# Seeds/Sq. Ft.	Lbs./Acre (PLS)
Graminoids							
Agropyron smithii	Western Wheatgrass	Arriba	20	435600	120000	10.0	3.63
Agropyron trachycaulum	Slender Wheatgrass	San Luis	10	217800	120000	5.0	1.82
Andropogon gerardii	Big Bluestem	Bonilla	10	217800	130000	5.0	1.68
Andropogon scoparius	Little Bluestem	Aldous	8	174240	225000	4.0	0.77
Bouteloua curtipendula	Side-Oats Grama	Vaughn	15	326700	190000	7.5	1.72
Bouteloua gracilis	Blue Grama	Hachita	15	326700	710000	7.5	0.46
Buchloe dactyloides	Buffalo Grass	Texoka	5	108900	45000	2.5	2.42
Koleria pyrimidata	June Grass		3	65340	2315400	1.5	0.03
Sorghastrum nutans	Indian Grass	Cheyenne	2	43560	120000	1.0	0.36
Sporobolus cryptandra	Sand Dropseed		7	152460	5298000	3.5	0.03
Stipa viridula	Green Needlegrass	Lodorm	5	108900	115000	2.5	0.95
	Total		100	2178000		50.0	13.86

Sq. ft/acre	43560
Seeds/sq. ft.	50
Seeds needed/acre	2178000

1) This pounds per acre assumes drill-seeding is used. If the seed is to be broadcast, the application rates are to be doubled.

2) PLS = pure live seed. Be sure to specify this to the seed dealer when ordering.

3) The seed is to be certified weed free.

4) Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species).
This allows Site ecologists to examine the seed for purity prior to seeding.

NOTE:
* The pediment tops are the upper flat surface areas throughout the IA.
Slender wheatgrass was added to species mix as an early successional species.

For questions regarding this spec sheet or if variances from these specifications are required contact the K-H Ecology Group at x2231, x3560, or x3687.

Red Map Areas

Hillside Slope Areas (Hillside Areas Or Areas With Slopes Greater Than 10%) Revegetation Specification Sheet

This Revegetation Specification Sheet Supercedes All Previous Revegetation Information For RFETS
Date: 1/04

Seedbed Preparation:

1. No imported topsoil will be used.
2. Soil surface is to be ripped or scarified to a depth of 2 –3 feet to relieve soil compaction, as needed.
3. Soil surface is to be disced to reduce soil particle size and get rid of larger clods, as needed.

Seed Mix:

1. Purchase attached seed mixture for the total number of acres to be reseeded. The values in the far right hand column are the amounts per acre to be used when drill seeding. Be sure to order the correct variety of seed. NOTE: For broadcast seeding, double the amounts shown in the far right hand column.
2. The seed is to be ordered as pure live seed (PLS).
3. The seed must be certified weed free.
4. Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species). This allows Site ecologists to examine the seed for purity prior to seeding.
5. Pull the seed bag tags off the bags and provide them to the K-H Ecology Group.

Seed Application:

1. Although no seeding windows are specified, greater success may be achieved when seeding is done in late fall, winter, or early spring.
2. The seed can be drill seeded or broadcast seeded over the disturbed areas. Make sure to use the correct amount of seed for the application method chosen.
3. For broadcast seeding, handseeding or mechanical seeders such as a centrifugal, fan, airblast, or hydroseeder are to be used to distribute the seed. After broadcasting, the area is to be drag-chained or raked to cover the seed slightly and provide better seed/soil contact. Broadcasting may be more appropriate on the steeper slopes for safety concerns.
4. Drill seeding is best used on the flat or shallow slope areas. For drill seeding, the seeding depth is to be between 0.25 inches and 0.5 inches. Because the Site is prone to high winds, drill seeding is to be done using two passes, with the applications being perpendicular to each other and 45 degrees offset from the predominant wind direction. Seeding should not be done when wind speeds are greater than 20 mph.
5. Seeding will be done prior to any mulch applications.

Soil Amendments:

No soil amendments will be added without approval of K-H Ecology Group.

Mulch Application:

The following guidelines should be used to determine the type of erosion control measures needed for revegetation applications.

Erosion Control Type	Percent Slope
Crimped Straw*	0 – 10%
Hydromulch*	0 – 15%
Erosion matting	>15%

*For larger areas, crimped straw is more appropriate and less expensive, whereas for smaller areas hydromulch may be more applicable because of equipment constraints.

For application of crimped straw and hydromulch follow the guidelines listed below. For application of erosion control matting, follow the manufacturers recommendations. Seed will be planted prior to application of erosion control mats.

Crimped Straw

1. Straw mulch is to be spread evenly across the revegetated area after seeding (drilled or broadcast) has been completed. It is to be applied at a rate of 1.5 tons per acre. NOTE: The straw must be certified as weed and pest free according to the Colorado Weed Free Forage Act. It should be either winter wheat or oats and not have an abundance of seed heads present in the straw.
2. The straw is to then be crimped into the soil to prevent it from blowing away. If crimping is not feasible, then after the straw has been blown onto the seeded surface it is to be covered with a chemical tackifier

following the manufacturers recommended application rate. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. Tackifier is to be applied at the manufacturer recommended rate per acre.

Hydromulch

1. Acceptable hydromulches include inert wood and plant fiber products (cellulose). Only tackifiers based on vegetable-based binders are acceptable at the Site to prevent undesired chemicals from leaching into the groundwater. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. The product known by the brand name "SoilGuard®" was also found to be chemically acceptable.
2. Hydromulch and tackifier are to be applied at the manufacturer recommended rates per acre.
3. Application of seed within hydromulch is <u>not</u> an accepted practice at the Site. Therefore areas are to be seeded (drilled or broadcast) prior to the hydromulch application. The hydromulch is to be applied with a tackifying agent to help prevent further erosion.

For questions or more information regarding this spec sheet or if variances from these specifications are required contact the K-H Ecology Group at x2231, x3560, or x3687.

Hillside Slope Areas (Hillside Areas Or Areas With Slopes Greater Than 10%) Revegetation Seed Mix
(Based on 50 seeds/sq.ft.)

Red Map Areas

This Revegetation Specification Sheet Supercedes All Previous Revegetation Information For RFETS
Date: 1/04

Species	Common Name	Variety	% of Seed Mix	# Seeds Needed	# Seeds/Lb.	# Seeds/Sq. Ft.	Lbs./Acre (PLS)
Graminoids							
Agropyron dasystachyum	Thickspike Wheatgrass	Critana	5	108900	150000	2.5	0.73
Agropyron smithii	Western Wheatgrass	Arriba	23	500940	120000	11.5	4.17
Agropyron trachycaulum	Slender Wheatgrass	San Luis	15	326700	120000	7.5	2.72
Bouteloua curtipendula	Side-Oats Grama	Vaughn	13	283140	190000	6.5	1.49
Bouteloua gracilis	Blue Grama	Hachita	24	522720	710000	12.0	0.74
Buchloe dactyloides	Buffalo Grass	Texoka	10	217800	45000	5.0	4.84
Stipa viridula	Green Needle Grass	Lodorm	10	217800	180000	5.0	1.21
	Total		100	2178000		50.0	15.90

Sq. ft/acre	43560
Seeds/sq. ft.	50
Seeds needed/acre	2178000

1) This pounds per acre assumes drill-seeding is used. If the seed is to be broadcast, the application rates are to be doubled.

2) PLS = pure live seed. Be sure to specify this to the seed dealer when ordering.

3) The seed is to be certified weed free.

4) Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species).
This allows Site ecologists to examine the seed for purity prior to seeding.

NOTE:
Slender wheatgrass and thickspike wheatgrass have been added to species mix as early successional species.

For questions regarding this spec sheet or if variances from these specifications are required contact the K-H Ecology Group at x2231, x3560, or x3687.

Brown Map Areas

Drainage Bottom Area Revegetation Specification Sheet

This Revegetation Specification Sheet Supercedes All Previous Revegetation Information For RFETS
Date: 1/04

Seedbed Preparation:

1. No imported topsoil will be used.
2. Soil surface is to be ripped or scarified to a depth of 2 –3 feet to relieve soil compaction, as needed.
3. Soil surface is to be disced to reduce soil particle size and get rid of larger clods, as needed.

Seed Mix:

1. Purchase attached seed mixture for the total number of acres to be reseeded. The values in the far right hand column are the amounts per acre to be used when drill seeding. Be sure to order the correct variety of seed. NOTE: For broadcast seeding, double the amounts shown in the far right hand column.
2. The seed is to be ordered as pure live seed (PLS).
3. The seed must be certified weed free.
4. Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species). This allows Site ecologists to examine the seed for purity prior to seeding.
5. Pull the seed bag tags off the bags and provide them to the K-H Ecology Group.

Seed Application:

1. Although no seeding windows are specified, greater success may be achieved when seeding is done in late fall, winter, or early spring.
2. The seed can be drill seeded or broadcast seeded over the disturbed areas. Make sure to use the correct amount of seed for the application method chosen.
3. For broadcast seeding, handseeding or mechanical seeders such as a centrifugal, fan, airblast, or hydroseeder are to be used to distribute the seed. After broadcasting, the area is to be drag-chained or raked to cover the seed slightly and provide better seed/soil contact. Broadcasting may be more appropriate on the steeper slopes for safety concerns.
4. Drill seeding is best used on the flat or shallow slope areas. For drill seeding, the seeding depth is to be between 0.25 inches and 0.5 inches. Because the Site is prone to high winds, drill seeding is to be done using two passes, with the applications being perpendicular to each other and 45 degrees offset from the predominant wind direction. Seeding should not be done when wind speeds are greater than 20 mph.
5. Seeding will be done prior to any mulch applications.

Soil Amendments:

No soil amendments will be added without approval of K-H Ecology Group.

Mulch Application:

The following guidelines should be used to determine the type of erosion control measures needed for revegetation applications.

Erosion Control Type	Percent Slope
Crimped Straw*	0 – 10%
Hydromulch*	0 – 15%
Erosion matting	>15%

*For larger areas, crimped straw is more appropriate and less expensive, whereas for smaller areas hydromulch may be more applicable because of equipment constraints.

For application of crimped straw and hydromulch follow the guidelines listed below. For application of erosion control matting, follow the manufacturers recommendations. Seed will be planted prior to application of erosion control mats.

Crimped Straw

1. Straw mulch is to be spread evenly across the revegetated area after seeding (drilled or broadcast) has been completed. It is to be applied at a rate of 1.5 tons per acre. NOTE: The straw must be certified as weed and pest free according to the Colorado Weed Free Forage Act. It should be either winter wheat or oats and not have an abundance of seed heads present in the straw.
2. The straw is to then be crimped into the soil to prevent it from blowing away. If crimping is not feasible, then after the straw has been blown onto the seeded surface it is to be covered with a chemical tackifier following the manufacturers recommended application rate. Tackifying agents found to be “environmentally friendly” and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. Tackifier is to be applied at the manufacturer recommended rate per acre.

Hydromulch

1. Acceptable hydromulches include inert wood and plant fiber products (cellulose). Only tackifiers based on vegetable-based binders are acceptable at the Site to prevent undesired chemicals from leaching into the groundwater. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. The product known by the brand name "SoilGuard®" was also found to be chemically acceptable.
2. Hydromulch and tackifier are to be applied at the manufacturer recommended rates per acre.
3. Application of seed within hydromulch is <u>not</u> an accepted practice at the Site. Therefore areas are to be seeded (drilled or broadcast) prior to the hydromulch application. The hydromulch is to be applied with a tackifying agent to help prevent further erosion.

For questions or more information regarding this spec sheet or if variances from these specifications are required contact the K-H Ecology Group at x2231, x3560, or x3687.

Drainage Bottom Area Revegetation Seed Mix
(Based on 50 seeds/sq.ft.)

Brown Map Areas

This Revegetation Specification Sheet Supercedes All Previous Revegetation Information For RFETS
Date: 1/04

Wet Areas Along Edge of Streambank or Pond Edge							
Scientific Name	**Common Name**	**Wetland Designation**	**% of Seed Mix**	**# Seeds Needed**	**# Seeds/Lb.**	**# Seeds/Sq. Ft.**	**Lbs./Acre (PLS)**
Graminoids							
Agrostis scabra	Hair Grass	FAC	20	435600	5000000	10.0	0.09
Carex nebrascensis	Nebraska Sedge	OBL	25	544500	534000	12.5	1.02
Eleocharis palustris	Longstem Spike Rush	OBL	10	217800	1240000	5.0	0.18
Juncus balticus	Baltic Rush	OBL	25	544500	500000	12.5	1.09
Scirpus americanus	Three-Square	OBL	15	326700	600000	7.5	0.54
Shrubs							
Amorpha fruticosa	Wild Indigo	OBL	5	108900	77000	2.5	1.41
	Total		100	2178000		50.0	4.33

Dryer Areas Away From Edge of Streambank or Pond Edge							
Scientific Name	**Common Name**	**Variety**	**% of Seed Mix**	**# Seeds Needed**	**# Seeds/Lb.**	**# Seeds/Sq. Ft.**	**Lbs./Acre (PLS)**
Graminoids							
Agropyron smithii	Western Wheatgrass	Arriba	15	326700	120000	7.5	2.72
Agropyron trachycaulum	Slender Wheatgrass	San Luis	20	435600	120000	10.0	3.63
Andropogon gerardii	Big Bluestem	Bonilla	15	326700	130000	7.5	2.51
Bouteloua gracilis	Blue Grama	Hachita	10	217800	710000	5.0	0.3
Elymus canadensis	Canada Wildrye	-	20	435600	115000	10.0	3.79
Panicum virgatum	Switchgrass	Nebraska 28	20	435600	390000	10.0	1.12
	Total		100	2178000		50.0	14.08

Sq. ft/acre	43560
Seeds/sq. ft.	50
Seeds needed/acre	2178000

1) This pounds per acre assumes drill-seeding is used. If the seed is to be broadcast, the application rates are to be doubled.

2) PLS = pure live seed. Be sure to specify this to the seed dealer when ordering.

3) The seed is to be certified weed free.

4) Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species).
This allows Site ecologists to examine the seed for purity prior to seeding.

NOTE:
Slender wheatgrass has been added to species mix an early successional species.

For questions regarding this spec sheet or if variances from these specifications are required contact the K-H Ecology Group at x2231, x3560, or x3687.

Temporary Seeding Revegetation Specification Sheet

This Revegetation Specification Sheet Supercedes All Previous Revegetation Information For RFETS
Date: 1/04

This specification sheet is be used where temporary vegetation cover for erosion control is required at locations that will be regraded and/or have final revegetation applied in the future.

Seedbed Preparation:

1. No imported topsoil will be used.
2. Soil surface is to be ripped or scarified to a depth of 2 –3 feet to relieve soil compaction, as needed.
3. Soil surface is to be disced to reduce soil particle size and get rid of larger clods, as needed.

Seed Mix:

1. Purchase attached seed mixture for the total number of acres to be reseeded. The values in the far right hand column are the amounts per acre to be used when drill seeding. Be sure to order the correct variety of seed. NOTE: For broadcast seeding, double the amounts shown in the far right hand column.
2. The seed is to be ordered as pure live seed (PLS).
3. The seed must be certified weed free.
4. Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species). This allows Site ecologists to examine the seed for purity prior to seeding.
5. Pull the seed bag tags off the bags and provide them to the K-H Ecology Group.

Seed Application:

1. Although no seeding windows are specified, greater success may be achieved when seeding is done in late fall, winter, or early spring.
2. The seed can be drill seeded or broadcast seeded over the disturbed areas. Make sure to use the correct amount of seed for the application method chosen.
3. For broadcast seeding, handseeding or mechanical seeders such as a centrifugal, fan, airblast, or hydroseeder are to be used to distribute the seed. After broadcasting, the area is to be drag-chained or raked to cover the seed slightly and provide better seed/soil contact. Broadcasting may be more appropriate on the steeper slopes for safety concerns.
4. Drill seeding is best used on the flat or shallow slope areas. For drill seeding, the seeding depth is to be between 0.25 inches and 0.5 inches. Because the Site is prone to high winds, drill seeding is to be done using two passes, with the applications being perpendicular to each other and 45 degrees offset from the predominant wind direction. Seeding should not be done when wind speeds are greater than 20 mph.
5. Seeding will be done prior to any mulch applications.

Soil Amendments:

No soil amendments will be added without approval of K-H Ecology Group.

Mulch Application:

The following guidelines should be used to determine the type of erosion control measures needed for revegetation applications.

Erosion Control Type	Percent Slope
Crimped Straw*	0 – 10%
Hydromulch*	0 – 15%
Erosion matting	>15%

*For larger areas, crimped straw is more appropriate and less expensive, whereas for smaller areas hydromulch may be more applicable because of equipment constraints.

For application of crimped straw and hydromulch follow the guidelines listed below. For application of erosion control matting, follow the manufacturers recommendations. Seed will be planted prior to application of erosion control mats.

Crimped Straw

1. Straw mulch is to be spread evenly across the revegetated area after seeding (drilled or broadcast) has been completed. It is to be applied at a rate of 1.5 tons per acre. NOTE: The straw must be certified as weed and pest free according to the Colorado Weed Free Forage Act. It should be either winter wheat or oats and not have an abundance of seed heads present in the straw.
2. The straw is to then be crimped into the soil to prevent it from blowing away. If crimping is not feasible, then after the straw has been blown onto the seeded surface it is to be covered with a chemical tackifier

following the manufacturers recommended application rate. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. Tackifier is to be applied at the manufacturer recommended rate per acre.

Hydromulch

1. Acceptable hydromulches include inert wood and plant fiber products (cellulose). Only tackifiers based on vegetable-based binders are acceptable at the Site to prevent undesired chemicals from leaching into the groundwater. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. The product known by the brand name "SoilGuard®" was also found to be chemically acceptable.
2. Hydromulch and tackifier are to be applied at the manufacturer recommended rates per acre.
3. Application of seed within hydromulch is <u>not</u> an accepted practice at the Site. Therefore areas are to be seeded (drilled or broadcast) prior to the hydromulch application. The hydromulch is to be applied with a tackifying agent to help prevent further erosion.

For questions or more information regarding this spec sheet or if variances from these specifications are required contact the K-H Ecology Group at x2231, x3560, or x3687.

Temporary Seeding Revegetation Seed Mix
(Based on 50 seeds/sq.ft.)

This Revegetation Specification Sheet Supercedes All Previous Revegetation Information For RFETS
Date: 1/04

Species	Common Name	Variety	% of Seed Mix	# Seeds Needed	# Seeds/Lb.	# Seeds/Sq. Ft.	Lbs./Acre (PLS)
Agropyron smithii	Western Wheatgrass	Arriba	25	544500	120000	12.5	4.5
Agropyron trachycaulum	Slender Wheatgrass	San Luis	40	871200	120000	20.0	7.3
Bouteloua curtipendula	Side-oats Grama	Vaughn	35	762300	190000	17.5	4.0
	Total		100	2178000		50.0	15.8

Sq. ft/acre	43560
Seeds/sq. ft.	50
Seeds needed/acre	2178000

1) This pounds per acre assumes drill-seeding is used. If the seed is to be broadcast, the application rates are to be doubled.

2) PLS = pure live seed. Be sure to specify this to the seed dealer when ordering.

3) The seed is to be certified weed free.

4) Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species).
This allows Site ecologists to examine the seed for purity prior to seeding.

For questions regarding this spec sheet or if variances from these specifications are required contact the K-H Ecology Group at x2231, x3560, or x3687.

APPENDIX C

IA Revegetation Areas
Soil Characterization Data
Rev. 2
January 2004

Industrial Area Revegetation Plan Soil Sampling

Problem

After remediation activities have been completed in the Industrial Area (IA) for various projects, revegetation of the locations is necessary to prevent soil erosion and to return the areas to a more native state. The seedbed into which seeding will take place consists of the material left after the remediation portion of the project is completed. Soil characterization sampling is being done to characterize soil conditions at revegetation locations to determine whether soil amendments will need to be added for optimal plant growth. For the best revegetation success it is important to know if any soil parameters are outside the range required for optimal plant growth.

Identification of Decisions

The characterization sampling and analysis question to be evaluated is:

1. Do the selected soil parameters at the revegetation locations fall within the range specified for optimal plant growth and revegetation success (Savage and Savage 2003)?

Inputs to the Decisions

Information needed to evaluate the confirmation sampling and analysis question are as follows:

1. List of soil parameters to measure and the range of optimal values for each parameter. See Table 1 below.

Table 1. Soil Parameters To Be Measured

pH
Electrical Conductivity (EC; mmhos/cm)
Sodium Adsorption Ratio (SAR)
Saturation (%)
Boron (ppm)
Selenium (ppm)
Textural Class
Coarse Fragments
Nitrogen (NO3)
< 1% organic matter
1-2% organic matter
>2% organic matter
Phosphorus
Potassium

2. Soil sampling locations.

3. Sampling results.

Study Boundaries

Samples will be collected from each of three broad categories identified for different seed mixes in the IA: flat areas, hillside slope areas, and drainage bottom areas. Figure 1 shows the general locations where soil samples will be taken initially. As additional areas are prepared for revegetation, additional samples may be collected.

For the flat area category (representing the pediment top in the IA), the solar ponds and the building footprints for T893A, T893B, and 125 have been selected for initial sampling. A total of 3 composite samples will be taken from these areas – one from the solar ponds, one from the T893A and T893B buildings, and one from building 125. For the hillside area category, three samples will be taken – one from the north-facing hillside where buildings 993 and 987 were located, one from the old PIDAS area west of the waste water treatment plan that was regraded as part of the solar pond project, and a one from a small disturbance along the north access road where a fence corner was removed. Table 2 summarizes the locations and number of samples to be taken. As additional hillside areas in the IA are prepared for revegetation, additional sampling will be conducted. For the drainage bottom categories, no samples will be taken currently since no areas in this category have been disturbed. Sampling for these areas will be conducted when these areas become ready for revegetation.

Table 2. Soil Sampling Locations and Number of Samples

Location	# of Samples	# Subsamples for Compositing
Solar Ponds	1	15
T893A and T893B	1	10
Building 125	1	10
Fence corner	1	4
Old PIDAS	1	10
Buildings 993 and 987 area	1	10
Total # Samples	6	

The soil samples will be collected and shipped to an off-site soil laboratory for analysis. A composite sample of the top 18 inches of plant growth medium from representative locations within the revegetation parcels will be collected for each sample. Specific locations for representative subsamples within the revegetation parcels will be subjectively selected and flagged in the field by Site ecologists. Randomization of subsamples is not required so that the apparent visual variability can be taken into account. Samples will be taken from areas recently revegetated. The subsamples from each location will be composited into one sample for each area to be sent to the laboratory for analysis. Site procedures and policies will be followed for the collection and shipping of samples. Soil volumes collected will be consistent with the amounts needed to conduct the laboratory analyses. Table 1 lists the soil parameters that are to be measured.

Results will be provided in hardcopy and electronic form to the K-H Ecology Group.

Decision Rules

The sampling and analysis decision rules that describe how the data will be evaluated are listed below.

1. Laboratory results for each composite sample will be compared to the range of suggested optimal values the CDMG column in Table 1 from Savage and Savage (2003). If any of the values for the parameters measured fall outside the optimal values listed in Table 1 evaluation of potential corrective actions will be taken.

Tolerable Limits on Decision Errors

The composite sampling method will provide a good overall measure of the soil conditions present at the revegetation locations. No statistical analysis is required or necessary for these data. A simple descriptive comparison of laboratory results to the values in Table 1 will be sufficient for the level of accuracy and scope required.

Optimization of Plan Design

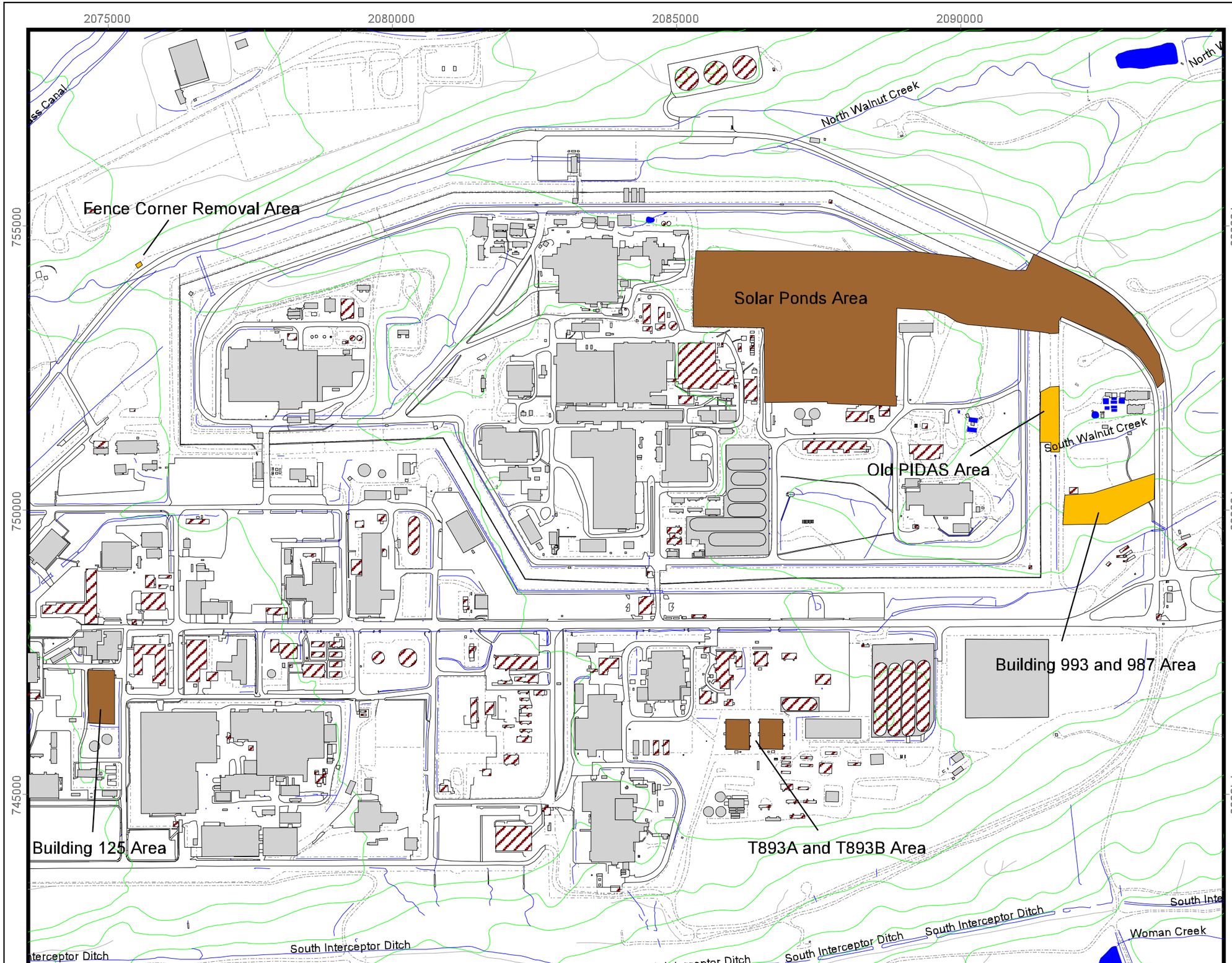
Optimization of this sampling design does not need to meet rigorous statistical analysis. It is a simple descriptive comparison of laboratory results to the values in Table 1 in Savage and Savage (2003) will be sufficient for the level of accuracy and scope required.

References

Savage and Savage. 2003. Rocky Flats Environmental Technology Site Industrial Area Revegetation Plan. Final Draft. Prepared by Savage and Savage, Inc., Louisville, CO for Kaiser-Hill Company, LLC. January 2003.

Industrial Area Revegetation Soil Sampling Locations

Figure 1



LEGEND

- Flat Areas Category
- Hillside Slope Areas Category

Standard Features

- Buildings
- Demolished Buildings
- Lakes & ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Contours (20 ft. intervals)

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95.

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N

1:5678

300 0 300 600 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: LABAT

For: Kaiser-Hill Company, LLC

RFETS GIS Dept. 303-966-7707

MAP ID: 03-0009

February 13, 2003

Q:\Projects\F72003\03-0009\soilsampling03.apr

Table 1. Rocky Flats Industrical Area Revegetation Soil Sampling Summary

	Mesic		Xeric		CDMG*
Soil Variable	**Mean**	**SD**	**Mean**	**SD**	
Nitrogen (ppm)	4.27	2.72	5.93	4.06	<6 ppm
% Organic Matter	1.66	0.43	1.39	0.45	
Phosphorus (ppm)	4.67	2.31	4.33	2.31	<3 ppm
Potassium (exchan; ppm))	170.00	60.00	126.67	15.28	<60 ppm
pH	7.43	0.29	8.23	1.01	<5.5, >8.8
Electrical Conductivity (mmhos/cm)	0.58	0.13	1.55	0.96	>8.0
SAR	1.17	0.72	1.50	1.11	>10
% Saturation	38.77	1.35	32.73	8.24	<25, >80
Boron (ppm)	0.07	0.02	0.25	0.28	>5 ppm, (pH >8.0)
Selenium (ppm)	0.00	0.00	0.00	0.00	>2.0, (pH >8.0)
Soil Texture	Loam		Loam, sandy loam		clay, siltclay, sand

n = 3 for each habtype

* CDMG = Colorado Division of Minerals and Geology unpublished guidance document (Savage and Savage, 2003)

APPENDIX D

Qualitative Revegetation Evaluation Form Rev. 2 January 2004

Qualitative Revegetation Evaluation Form Form #_____

Date_____
Observer(s)_____
Location ID_____

Photographs taken today? Y N

Are seeded plant species present? Y N

Which seeded species are present? How abundant are the seeded species? Estimate overall cover of each seeded species using the following cover class system (1 = <5%; 2 = 6-25%; 3 = 26-50%; 4 = 51-75%; 5 = >75%). Comments on their condition.

_____
_____
_____
_____
_____
_____
_____

Any evidence of nutrient or water deficiencies? If so, describe. _____
_____
_____
_____

Are noxious weeds present? Y N

If yes, what species of noxious weeds are present? How abundant are the noxious weed species? Estimate overall cover of each noxious species using the following cover class system (1 = <5%; 2 = 6-25%; 3 = 26-50%; 4 = 51-75%; 5 = >75%).

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Are other weedy species present? Y N

If so, what species and how abundant are they? Estimate overall cover of each weedy species using the following cover class system (1 = <5%; 2 = 6-25%; 3 = 26-50%; 4 = 51-75%; 5 = >75%).

_____
_____
_____
_____
_____
_____
_____
_____

Total Vegetation Cover (Estimate to nearest percent) _____

Suggestions for management:_____

_____

_____

_____

_____

_____

Other comments:_____

_____

_____

_____

_____

_____

Completed by:_____Date_____

Print Sign