BUTTE HILL REVEGETATION EVALUATION

BUTTE-SILVER BOW CITY-COUNTY, MONTANA

Prepared for

Butte Natural Resource Damage Restoration Council
and
Montana Natural Resource Damage Restoration Program

Prepared by
Herrera Environmental Consultants, Inc.

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Prepared for
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Note:
Some pages in this document have been purposely skipped or blank pages inserted so that this document will copy correctly when duplexed.

INTRODUCTION

The purpose of this report is to evaluate if the revegetation projects on the Butte Hill, funded with monies from the Butte Area One Restoration Fund, are successful, feasible and cost effective, and to make recommendations on how those revegetation efforts might be improved. The recommendations in this report have two goals. The first is to improve the methods to more closely match the successful methods employed by the reclamation/restoration industry. The second goal is to provide suggestions to reduce costs and increase the amount of revegetation that can be conducted with available funds.

The Butte Area One Restoration Plan dedicated $3 million to three revegetation projects on the Butte Hill. These projects are aimed at enhancing the covers on mine waste areas by adding native plant/species diversity to increase the prospects for long term survivability and improved soil stability. Natural Resource Damage Program (NRDP) partners in this project include the Butte Natural Resource Damage Restoration Council (BNRC), the Butte-Silver Bow (BSB) Planning Department, the Montana Tech Native Plant Diversity Program, and Landscapes of Montana (Norm DeNeal). This restoration work began in spring of 2012, and so far approximately $555,000 has been invested in the effort.

Butte-Silver Bow Tree Planting Project

The overall statement of work for this project is: "to restore the vast landscape on the Butte Hill and re-establish native species diversity in open-space areas with an emphasis on erosion resistance and reducing sediment loading to Silver Bow Creek by planting hundreds of mature trees and shrubs that will restore small wildlife habitat and re-establish a diverse, self-sustaining vegetative cover on the reclaimed areas."

Adherence to Scope of Work

During the meetings with the Butte-Silver Bow Staff and a review of the progress reports, we determined that the Scope of Work has been followed but methods and activities could be modified to provide better results. The recommendations section of this report will specify some of those potential improvements.

The 2012 Expedited Planting Project (Contract 600290)

Planting Goals 2012

1. Granite Mountain Memorial Interpretive Area
2. Mountain Con Mine Yard Park
3. Syndicate Pit Area
4. Several smaller areas.

The overall goals of this contract stated: "All plantings were designed to contribute to the more comprehensive goal on the Butte Hill to minimize erosion and enhance the vegetative caps over reclaimed areas through greater diversity and stability."

2012 Results

Progress reports provided in September 2013 indicated that all of the areas except the smaller planting areas had been completed.

Planting Goals 2013

1. Upper Missoula Gulch
2. Granite Mountain Memorial Interpretive Area
3. Walkerville Baseball Field
4. BA&P Walking Trail
5. Several Small Areas.

2013 Results

Soil pods were established by salvaging topsoil, removing mine waste, placing crushed limestone in the excavated hole and filled with imported top soil. Trees were planted with most large ball and burlap nursery stock. All of the areas targeted were completed by September 2013 except for the "Small Areas."

Butte-Silver Bow Soil Testing and placement, Tree and Shrub Planting Project (Contract 80006-10293)

Goals 2014

1. Select priority planting areas
2. Plant trees and shrubs
3. Promote stewardship through public education about revegetation project.

2014 Results

Tree planting pods were located and constructed and trees were planted in the following areas:

- Texas Avenue Revegetation Project
- BA& P Hill Trail

In addition, tree planting pods were excavated and will be planted in the 11th Street Triangle Planting area in the fall of 2015.

Observations

The work done by Butte-Silver Bow since 2012 has been very well done and the Scopes of Work have been followed. The material costs have been accurately accounted for and the care and maintenance of the plantings has been adequate. A high percentage of the plants installed are surviving. However, the methods employed by this project are more geared to landscaping than to native plant restoration (see photo 1 in Appendix A).

Invoice Review

The invoices for materials were reviewed with Tom Malloy and were determined to be complete and reasonable.

Care and Maintenance of Plantings

The care and maintenance of plants has been adequate, with some issues of disease in Mountain Ash and better weed control. Irrigation amounts may be excessive (see comments in recommendations section below).

Percent Survival of Plantings

A high percentage of plantings are surviving (over 80%).

Progress Toward Meeting Goals

The goals of re-establishing native species diversity with an emphasis on erosion resistance are not being met with the existing approach. The landscape is very large and the cost per acre of the current treatment is so high that a significant impact on plant diversity and erosion control cannot be achieved with the funds available. Standard native plant restoration techniques could be employed that would better utilize funds and restore larger areas (see photo 2 in Appendix A).

Recommendations

The purpose of this section is to provide recommendations to improve and strengthen the program. On September 8, 2015, Len Ballek met with Mr. Tom Malloy to go over invoices and progress reports then visited some planting sites in the afternoon. On September 9, he visited more sites with Mr. Malloy, Eric Hassler and Julia Crain. Then on October 8, Mr. Ballek met with the BSB staff and reviewed his recommendations.

Smaller individual pods rather than large pods would spread out the visual impact. BSB has done some of these and they appear very natural. Pods could also be planted with one or two large trees (for immediate visual impact) along with smaller 1 to 2-foot container trees. The smaller plants would not require supplemental irrigation and the planting would result in a more natural appearance with several age classes of trees. This method would also reduce costs.

The treatment of soils is a very substantial cost for the projects. Contaminated waste must be removed to provide the appropriate rooting depth for trees. But trees do not need deep topsoil to thrive. The excavated pods with a lime layer could be filled with 4 feet of clean fill and 1 foot of good top soil. This would provide the root depth for trees and the soil needed for effective grass and shrub establishment within the pods. This would also be a substantial reduction in cost (see photo 3 in Appendix A).

Native shrubs and wild flowers are not as deep rooted as trees and small containers of shrubs and wildflowers such as blue lupine, blanket flower, sage brush, rabbit brush, currant and Wood's rose and could be successfully planted in the existing 18-inch cover. This would result

in cost savings and extensive shrub and wildflower communities that provide excellent erosion control, habitat and plant diversity along with a beautiful landscape.

Montana Tech has the staff and facilities to provide locally collected native plant seed and plants grown from that seed. They can also provide seed that is pre-treated to enhance germination. There are also a number of excellent Montana Nurseries that track the seed sources of the plant material (a list of these suppliers is included in the appendix of this report). The use of only natives is critical for establishment of self-sustaining plant communities. Any purchase of plants should require a determination of the seed source and any material not from a western Montana seed source should be used.

The salvage of aspens and other trees from BSB property should be considered. High quality tree spades are available for rent and a few days of harvesting could provide a large number of low cost trees.

Another option is to contract with a local nursery provider to custom grow trees in “root control bags”. This method produces well rooted and high quality trees that have better survival and growth rates than “ball and burlap”.

The current grass seed mix that is primarily non-native should be revised and presented to the EPA for approval. This mix should contain major species native to the site with some type of sterile hybrid grass and several native forbs and/or shrubs.

The only disease that was noted on the plantings is a severe problem of fire blight on the mountain ash. Fire blight is a major disease for this species and the use of irrigation and resulting moist conditions encourages the spread of fire blight. We suggest the elimination of mountain ash from future plantings or focus the irrigation on the plantings to only the large trees (see photo 4 in Appendix A).

The planting of large trees should include the installation of appropriate fertilizer packs that include slow release fertilizers and mycorrhizal inoculum. This would improve the establishment of plantings.

The use of "Bio-char" as a soil amendment is a new technique that shows good promise for native plantings. “Bio-char” is a product of burning woody debris with little oxygen. Bio-char has been used in the industry but is not common. Herrera has no direct experience in the efficacy of the method so cannot recommend it. It is suggested as an approach to consider and it may take some extensive literature research to make a decision about using it as a soil amendment.

Past installation of large trees has included the traditional landscape technique of staking and tying the trunks to prevent the wind from loosening the root balls before they can become established. Newer techniques utilize a technique that stakes the actual tree ball. This method reduces the labor for staking, eliminates any maintenance and removal of the stakes, and actually is healthier for the trees (see photo 5 in Appendix A).

Seedling shrubs and wildflowers can be planted by hand and this technique is a standard reclamation method that has been used successfully for over 30 years. A 2-foot by 2-foot planting area should be scraped to remove all existing vegetation. A seedling is then planted in the center of this "scalp." A 3 by 3-foot fabric weed barrier is then installed and stapled to fasten it to the ground. If planted in the right places and during the dormant period (spring or fall), these plants have no irrigation or other maintenance requirements, have excellent survival at a very low cost.

Browsing by wildlife has been a problem for some of the plantings on the project. There are several effective browse repellents that work well to limit this damage. Several of the planting sites have had damage from pocket gophers and trapping can effectively address this issue. (see list of materials and suppliers in Appendix B).

The reclamation/restoration industry has used a number of hand tools and methods that are very effective in the installation of native plants. See Appendix B of this report for a list of typical planting equipment and suppliers for the equipment, fertilizer and mycorrhizal inoculum, weed barriers, staking material, and browse repellents.

An irrigation plan should be developed for all plantings. The goal of this plan would be to promote longevity and survival of the plantings once irrigation is removed. Such a plan would first determine the proper duration and volume of water provided. A soil auger could be used to determine the depth of water penetration to calculate what length of irrigation time is best suited for maximum/ideal saturation. A watering schedule would then be developed for June 1 through October. The next year the irrigation could be reduced by down by 1/3, and in the third year another 1/3. This would ensure that the plantings have deep roots to keep them growing and thriving without irrigation.

The maintenance of planting areas should focus on the removal of noxious weeds and proper irrigation. Native plants naturally have some die back of branches and some mortality. The dead material provides habitat for birds and other wildlife. The only time dead material should be removed is if the planting site is in a park setting or if the local residents are concerned. Education of the public about the importance of leaving the plantings in a natural state (even with some dead plants or branches) would be helpful and the cost of maintenance could be reduced.

The best time to plant native plants is when they are in a dormant condition. This would be in the spring before June 1 or between September 15 and October 30. Seeding of grass mixes can be planted in the spring or fall.

Montana Tech Native Plant Diversity Program

The overall statement of work for the Montana Tech program is to "Re-establish a diverse, self-sustaining native plant community on the reclaimed areas of the Butte Hill". The Objectives developed to meet this goal are:

1. Produce dispersal islands of diverse native plant communities

2. Determine which native forbs and shrubs will be the most likely to re-establish on reclaimed areas

Adherence to Scope of Work

During the meetings with the Montana Tech program staff and a review of the progress reports, the Scope of Work has been followed but methods and activities should be modified to provide better results. The recommendations section of this report will specify some of those potential improvements.

Tasks listed in the contract are:

1. Collect seed from the nearby, native forb and shrub communities.

Native seed has been collected each year of the project but it included over 80 species many of which are not appropriate for revegetation on the Butte Hill.

2. Maintain and expand the seed orchard on the Montana Tech campus. The expansion will accommodate shrubs and a greater variety of forbs.

The native seed orchard has been expanded and is providing a source for seed. The maintenance of the orchard has not been sufficient to provide conditions that would lead to the production of volumes of seed appropriate for projects.

3. Produce 3 lbs. of forb/shrub seed each year through collection efforts in the seed orchard and nearby native communities.

Three pounds of seed were collected in 2014 but it included many riparian plant species that are not appropriate for restoration on the Butte Hill

4. Operate and maintain the Montana Tech greenhouse which will function as the center of seed management. Seeds will be dried, cleaned and stored; then treated to initiate germination. Those seedlings that 'pot up' will be grown in the greenhouse until they are mature enough to be hardened outside. The greenhouse will also maintain a supply of containerized young plants until they can be transplanted at dispersal islands (see photo, 6 and 7 in Appendix A).

Seed was processed and stored and seedlings were produced. However, many of the species (including willow) were not appropriate for the Butte Hill

5. Expand the "over-wintering shed" capacity at the Montana Tech campus.

Excellent over-wintering facilities have been developed and will be valuable for future native plant production

6. Produce at least 60 forb sod mats per year. Each mat will be one square meter.

Forb sod mats have been produced each year. This is a very expensive method of establishing native plants and future applications should be limited to "Landscape Applications" that need immediate visual effects. Perhaps some sod mats would be best utilized within the BSB tree pods to provide ground cover and weed suppression (see photo 8 in Appendix A).

7. Apply the annually produced 3 lbs. of seeds, along with 15 lbs. of native forb seed and 2 lbs. of native shrub seed that was produced through previous efforts, for plantings coordinated with NRDP and BSB over the term of this contract.

Seed has been applied on a number of sites throughout the term of this contract.

8. Coordinate with NRDP, BSB, DEQ, EPA, BP/ARCO and other entities to identify planting locations and opportunities. This will require attending and participating in various Superfund and community meetings.

Some coordination of efforts was conducted. However, long term planning that could have resulted in the MT Tech Nursery providing substantial numbers of plants for the BSB projects and the Cellar Dirt Dump project did not occur.

9. Establish native forb and shrub dispersal islands through the installation of fob sods, direct planting of seeds and transplanting of containerized plants. These dispersal islands will be maintained until some degree of self-sufficiency is established.

Dispersal islands were established through the use of sods, seeding and containerized plants. These islands have established well.

10. Inspect and evaluate the dispersal islands. Determine which species are surviving, propagating and spreading. Determine which planting techniques and which locations are producing the greatest success. Make subsequent adaptations to increase the probability for achieving the project goal.

The current Montana Tech program staff has a plan for evaluating the islands and have been developing several ideas of how to improve this approach.

11. Promote stewardship among the community and make information about this project available locally by attending and presenting information at community meetings and symposiums and by preparing outreach materials (see photo 9 in Appendix A).

Montana Tech staff have done a good job of presenting information to the public and with the Emmet and Henry Trail project completed in spring 2015. This planting has attracted the attention of the local residents and labels for the native species planted there have been ordered and will provide excellent public education about the importance of the native plant revegetation efforts on the Butte Hill. Staff have also spoken at several community events and have worked with some volunteers on planting projects.

Invoice Review

In a thorough review of the program invoices it is evident that the materials billed have been well accounted for. No excessive material or labor costs were noted.

Care and Maintenance of Plantings

The field visits provided some insight into how well the maintenance of plantings been conducted. Sufficient weeding and watering has been conducted and the plantings are in good condition. The current Montana Tech staff approach is that if the sites are planted with the proper material and at the correct time, little or no watering is needed. This approach is the standard in native plant restoration projects in the arid west.

Percent Survival of Plantings

The percentage of surviving plantings is fair to good. The sod mats are almost all surviving although the more drought tolerant species in the mats have out competed the other species and are dominating the species mixes. However, the goal of the mat project was to provide islands of native vegetation that would spread and provide increased native diversity. The islands survived, but they did not "disperse" seeds and propagate the forbs as hoped. The Montana Tech monitoring study of the plantings (Presented to the BNRC in March of 2015) found that the sods often died back to just a few or even just one species and/or that the crested wheatgrass on the reclamation was too dense and prevented forb seeds from taking root. These mats are not resulting in a spread of diversity but are only providing very small areas of native plants at an extremely high cost. The container plants have survival rates that seem to be in the 50-70% range which is a typical survival rate in this type of site. The seeding has had variable results with some species doing well and others not germinating at all.

Progress Toward Meeting Goals

The project goal to "Establish dispersal islands of diverse native plant communities" has not been met. The islands have been successfully established, however, because the surrounding area is heavily vegetated with non-native crested wheatgrass and alfalfa, very little dispersal of the natives planted has occurred. The additional goal to "Determine which native forbs and shrubs will be the most likely to re-establish on reclaimed areas" will be met when the planned monitoring of the project sites provides this information.

Recommendations

The Montana Tech growing facilities and professional staff are valuable assets for successful re-establishment of a diverse, self-sustaining native plant community on the reclaimed areas of the Butte Hill. The following are based upon the meetings with the staff, observations of the completed sites and over thirty years of personal experience in restoring native plant communities in the Clark Fork Basin and throughout the arid west.

The first and most important recommendation is to conduct a study of the surrounding native plant communities and develop reference sites that match the aspect, slope and hydrologic conditions of the reclaimed areas on the Butte Hill. These reference sites could then be

mapped in a Geographical Information System Platform and then related to similar sites on the Butte Hill. This would provide valuable information about the species and distribution of the native plants adapted to the specific site conditions. There is currently a graduate student at Montana Tech who has developed the initial framework for such a tool and with some effort from Tech staff and students, this could result in a map of the Butte Hill that shows native plant vegetation types that are best adapted to each site. This would provide a systematic planning tool to select future sites and would determine the plant materials needed for each of the sites.

The current BRES system and the GIS tools in use by BSB were not evaluated. The GIS tool suggested collects vegetation data from undisturbed areas (Reference Sites) near Butte and provides a list of species and density that can be expected to establish well on sites on the Butte hill that match the Reference Sites in aspect, elevation, slope and position on the slope. The current BRES System and GIS tools does not provide the information to properly select the appropriate native species mix for the Butte Hill.

Effective and clear coordination of the project on the Butte Hill is needed to guide the project managers for the Montana Tech program as well as the other revegetation efforts. This coordination would plan efforts several years into the future and would allow the Montana Tech seed collection and growing facilities to be used to their potential as a growing operation to provide low cost site adapted native plant material for all the Butt Hill projects. The Montana Tech goals should be revised to be more specific and measurable.

An inventory of the seed and plants currently in inventory should be reviewed and the species not appropriate for the Butte Hill should be donated to other restoration projects where they are more appropriate. The cost of maintaining this material needs to be eliminated.

The use of forb sod mats should be eliminated or utilized only in very specific applications. This is a method that is not generally accepted in the native plant revegetation community and is much more expensive than seeding or planting of small container plants (see photo 10 in Appendix A).

The emphasis on the seed collection and plant production of forbs should be changed to include a greater focus on native shrubs that provide better erosion control than forbs. In addition, the seed collection and production of native tree seedlings should be increased to provide trees that are adapted to conditions found on the site.

Montana Tech professional staff should be encouraged to develop some methods of eliminating the non-native plant community currently dominating the Butte Hill without threatening the integrity of the past reclamation.

Dr. Pal and Krystal Weilage are committed to updating the Montana Tech Program to fully utilize the staff and facilities to provide a high level of value to all of the revegetation efforts on the Butte Hill (see photo 11 in Appendix A).

Landscapes of Montana Cellar Dirt Dump Restoration

The goal of this project is to demonstrate that a diverse, self-sustaining native landscape, including aspen along with various forbs and shrubs, can be reintroduced to the Butte Hill for a moderate cost. Once established, this native landscape would eventually require no maintenance and should ultimately provide a greater degree of erosion prevention to the waste cover and better habitat for native wildlife. This first phase of the project should help establish the costs and requirements for reestablishing diverse vegetative covers at other sites on the Butte Hill.

Adherence to Scope of Work

Based on meeting with Mr. DeNeal and a review of the progress reports, the Scope of Work has been followed but methods and activities could be modified to provide better results. The Recommendations section of this report will specify some of those potential improvements.

Invoice Review

In a thorough review of the program invoices it is evident that the materials billed have been well accounted for. No excessive material or labor costs were noted. Mr. DeNeal has done an excellent job of managing costs and because of this, he will be increasing the project size with no increase in the budget.

Care and Maintenance of Plantings

The field visits demonstrated that the maintenance of plantings been excellent. Careful weeding and watering has been conducted and the plantings are in excellent condition. The current approach is to provide consistent watering and weeding to ensure good survival of the aspens, shrubs and forbs.

Percent Survival of Plantings

The percentage of surviving plantings is excellent. Mr. DeNeal reported that some of the forb seeding was excellent and others did not do as well. The forb plantings in particular look very good (see photo 12 in Appendix A).

Progress Toward Meeting Goals

The project goal: “To demonstrate that a diverse, self-sustaining native landscape, including aspen along with various forbs and shrubs, can be reintroduced to the Butte Hill for a moderate cost” has been achieved. The results of the goal to: “eventually require no maintenance and should ultimately provide a greater degree of erosion prevention to the waste cover and better habitat for native wildlife” will be not be seen until the irrigation and weeding of the site is concluded. This first phase of the project should certainly help to: “establish the costs and requirements for reestablishing diverse vegetative covers at other sites on the Butte Hill.”

Recommendations

Mr. DeNeal's success on this project is very commendable and some modifications of the techniques and materials used will further increase the performance of future plantings (see photo 13 in Appendix A). The following recommendations are based upon the meetings with Mr. DeNeal, observations of the project sites and over thirty years of personal experience in restoring native plant communities in the Clark Fork Basin and throughout the arid west.

The first and most important recommendation is to develop an irrigation plan to systematically reduce the amount of irrigation of these plantings over the next three years. This will ensure that the plantings will be self-sustaining when irrigation and maintenance efforts are discontinued. This plan should have specific steps that include: timing and actual inches of water applied; how irrigation application will be modified to respond to extremely low or high precipitation events; the seasonal irrigation plan; and a specific schedule of how the irrigation will be reduced over time.

In order to have the aspen planting projects better blend into the environment, it is suggested that the planting area outlines should not be blocks with straight lines but more natural appearing shapes (see photo 14 in Appendix A).

The survival of aspen plantings on this project has been excellent and there is some spread of new seedlings from the plantings. It is suggested that the spacing be increased to reduce costs further and to take advantage of the aspen's natural ability to spread by root sprouts.

The Montana Tech Nursery and staff have the capability to collect native aspen seed from the Butte area and produce container seedlings. It is suggested that a pilot testing of this should be conducted to determine if the seedlings will perform as well as the bare root stock. If implemented on future projects, it would ensure that aspen planted will be adapted to Butte Hill site conditions.

Montana Tech is establishing reference sites in the Butte area to determine species that are naturally adapted to the sites to be planted on the Butte Hill. To ensure that species planted or seeded are appropriate for the planting sites, it is recommended that Mr. DeNeal review his species list with Dr. Pal at Montana Tech.

Effective and clear coordination with the Montana Tech program should occur to plan future planting efforts. This would allow the Montana Tech seed collection and growing facilities to be used to their potential to provide site adapted native plant material by collecting seed, growing container stock and by treating seed prior to planting to ensure high germination for Mr. DeNeal's projects.

Mr. DeNeal should be very careful to ask for specific seed sources for any plants or seed that he purchases for use on his project. Plant material or seed that is not from Montana should not be used. This will ensure that the plantings will be self-sustaining and effective.

COMPARISON OF METHODS TO STANDARD RECLAMATION/RESTORATION METHODS

The methods used on the projects funded by the program are closer to landscaping methods than to those that have been developed by the reclamation/restoration industry and which have proven to be successful. The differences are in: the size and type of plant materials, species mixes, planting methods, and maintenance.

Landscaping methods focus on establishing large plants. The most critical factor in the establishment of native plantings is the root to shoot ratio. A plant with a large top (shoot) and small root system is not able to establish well without irrigation. The growth rate of plants with an unbalanced root to shoot ratio is also slow because the plant is forced to put its energy into development of a root system instead of top growth. Using large plants provides instant visual effects but at a cost to establishing a self-sustainable plant. Smaller plants with more root depth and volume compared to the tops have much better survival, require little or no irrigation and will often catch up with larger plants installed at the same time within 4-5 years.

Landscaping may use native and selected or introduced species. A restoration approach utilizes only native plants. The goal of the project is: "… to restore the vast landscape on the Butte Hill and re-establish native species diversity". Native plants are those that would naturally grow on the Butte Hill. The coniferous trees that would be expected are: Douglas fir, lodge pole pine, Rocky Mountain juniper and perhaps ponderosa pine. Some deciduous trees that would occur include aspen, and cottonwood and willow in wetter sites. Examples of shrubs native to the site would likely include: creeping juniper, woods rose, sage brush, currant and rabbit brush. The past plantings on the hill have included quite a few non-native species and some Montana natives that are not native to sites like the Butte Hill. It is recommended that BSB work closely with MT Tech and Mr. Mariano's GIS program to determine the proper plant mixes for each planting site. The only time that non-natives should be used is in the case of a specific request by neighbors for plantings in a streetscape or in a park setting.

The methods used on the Butte Tree Planting and Dirt Cellar projects are primarily those used in the Landscaping industry. They include the use of ball and burlap trees, one gallon containers and bare root trees. Reclamation/restoration projects utilize smaller plants grown in deep containers. One example of a deep container is "tubelings" which are usually 1 inch in diameter by 8 inches deep and up to 14 inches deep (the Montana Tech Plant Diversity Program grows this type of plant material in their nursery). Other deep containers tree pots 4 by 4 by 14 inches deep and up to 24 inches deep. These containers provide a plant with a deep hardy root system that needs little or no irrigation and will develop a strong root system that is able to handle the dry summers and short seasons found on the Butte Hill.

Reclamation/restoration methods focus on establishing plant communities that are able to be self-sustaining without extensive maintenance. The current revegetation projects on the Butte hill include intensive irrigation and weeding. The weeding is required because weeds are encouraged by watering. In addition, large ball and burlap trees require more maintenance than smaller plantings.

SUMMARY RECOMMENDATIONS

Butte-Silver Bow County, Montana Tech and Mr. DeNeal should be thanked for their accomplishments in restoring native plants to the Butte Hill. They are all dedicated and hardworking people. The following recommendations should be taken as a list of ways to improve their efforts.

There are a lot of resources for learning about native plant revegetation. Attendance at training sessions when they are available would provide staff with the knowledge to further improve the planting program. A list of resources is included in the appendix of the report that could also provide valuable guidance.

Because one of the major goals of this project is "erosion resistance and reducing sediment loading to Silver Bow Creek" the placement of planting strips in areas upslope of reclaimed areas could intercept much of the "run on" to the capped areas. Likewise, planting downslope of the capped areas and in the drainages such as Missoula Gulch, could intercept and hold much of the "run off" from the slopes. These plantings may also be in areas of no waste so the planting techniques would not require waste removal. The planting costs would therefore be much lower than planting on the capped sites. It is suggested that this approach would provide much more erosion control and sediment reduction than the current approach of planting on the capped areas.

BSB has accurate maps of the reclaimed areas for revegetation applications. However, there needs to be an ecological approach to siting specific types of plantings such as aspen patches, conifers, drought tolerant shrubs and riparian trees and shrubs. Mark Mariano (a graduate student at MT. Tech) is developing a Geographical Information System (GIS) tool to map vegetation types on native sites near Butte. He is working on lists of plants that naturally occur on sites similar to the potential planting sites on the Butte Hill. This GIS tool should be used to determine the proper planting pallets for specific sites on the project site and would show the locations of areas that will support specific native plant communities. This technique would further ensure long term sustainability of plantings. In addition, there are some areas with deeper cover soils and others with no contaminated waste issues. Sites with northerly aspects and/or moister conditions should be targeted for mass plantings of tree and shrub seedlings to provide dense forest areas in the future (at a very low cost).

An irrigation plan should be developed for all large tree plantings to promote longevity and survival of the plantings once irrigation is removed. An appropriate plan would develop a watering schedule for June 1 through October the first year. The schedule would gradually reduce the amount of irrigation each year for 3-4 years. This would ensure that the plantings have deep roots to keep them growing and thriving when irrigation is removed.

In order to be able to obtain appropriate and lower cost plant material it is critical to plan several years ahead. A wish list for trees, shrubs, wildflowers and seed should be prepared with a 2 to 3-year lead time. Communicating this list with the MT Tech nursery will allow

them to collect seed and produce seedlings. A similar communication with tree suppliers will give them the time to find high quality Montana trees. This would require the appointment of a specific person to coordinate all of the future planting efforts. It would be the responsibility of the revegetation coordinator to keep a schedule of future projects, plan for plant material production or purchase, make sure that planting crews are available and ensure that the revegetation methods are utilizing the best restoration/revegetation science possible and to evaluate yearly each of the planting programs. This coordination would result in better plant establishment and diversity, reduction in sedimentation, increased habitat values and aesthetic appearance at a lower cost to the program.

An alternate approach to successful coordination would be to have BSB select the sites to treat based upon reducing sediment transport or storm-water flows on or off reclamation sites. Once those sites are selected, Montana Tech staff would suggest the most appropriate revegetation techniques and species mix. When the sites and treatments are agreed upon, BSB, Montana Tech, would meet to set a schedule for plant acquisition and planting. In addition, if Mr. DeNeal has aspen projects for which he needs plant material or other support, BSB and Montana Tech staff should try to accommodate his requests for the good of the restoration effort. Monthly meetings are suggested to ensure that the plans are on track.

APPENDIX A

Photographs

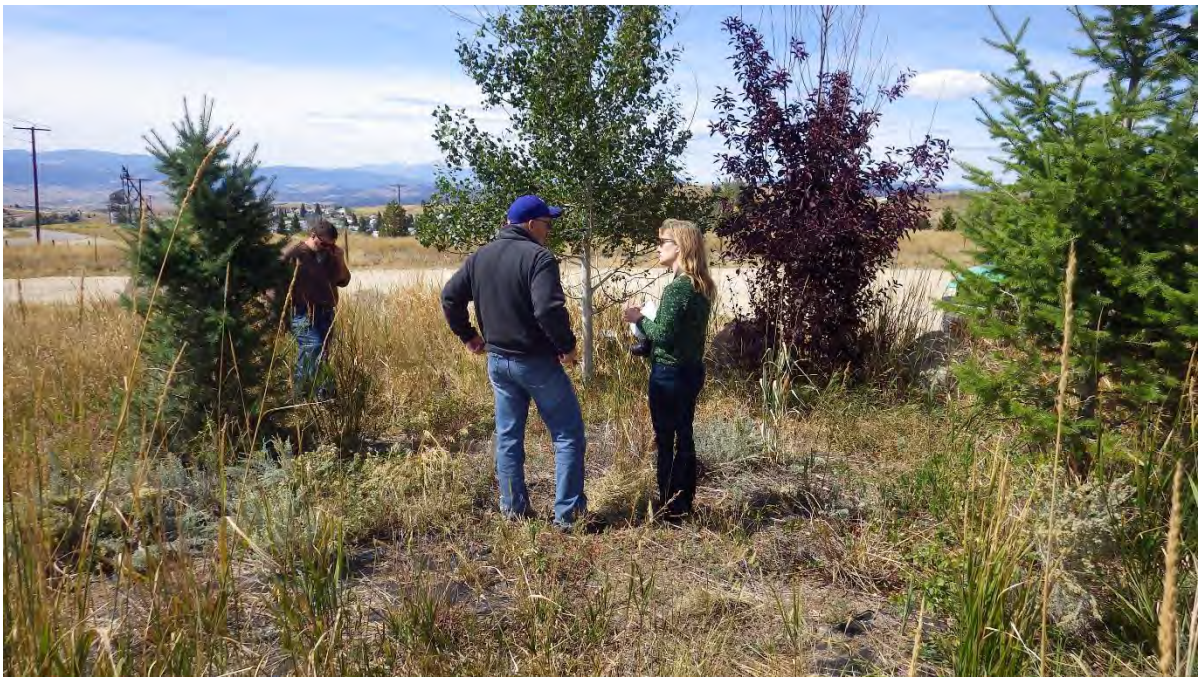

Photo 1. Butte Silver Bow tree planting

Photo 2. Typical tree planting pod in the landscape

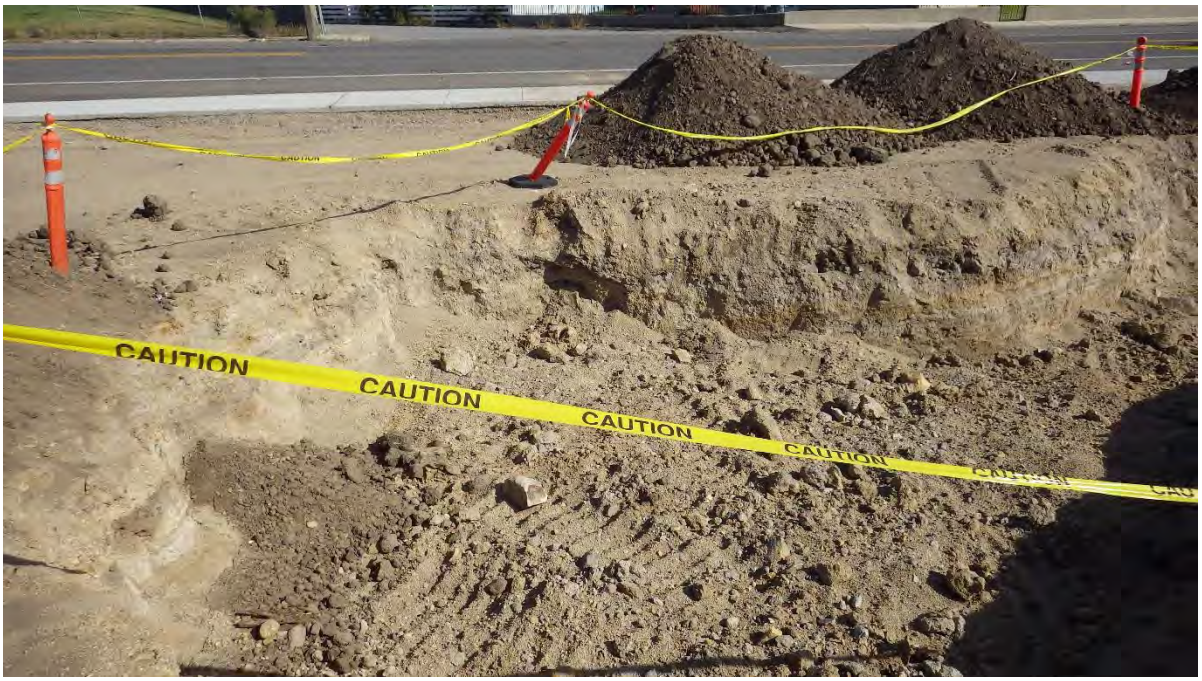

Photo 3. Tree pod excavation


Photo 4. Mountain ash fireblight

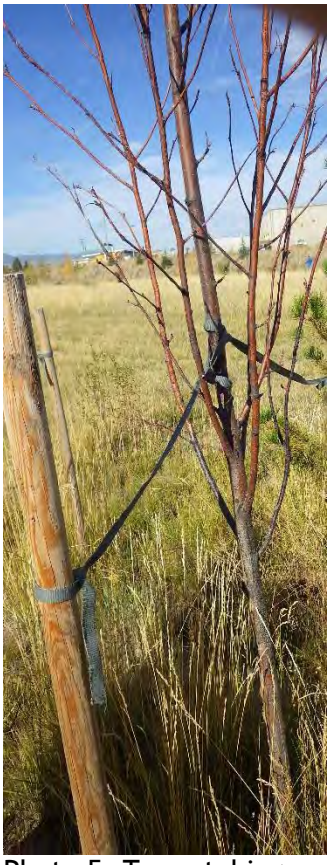

Photo 5. Tree staking

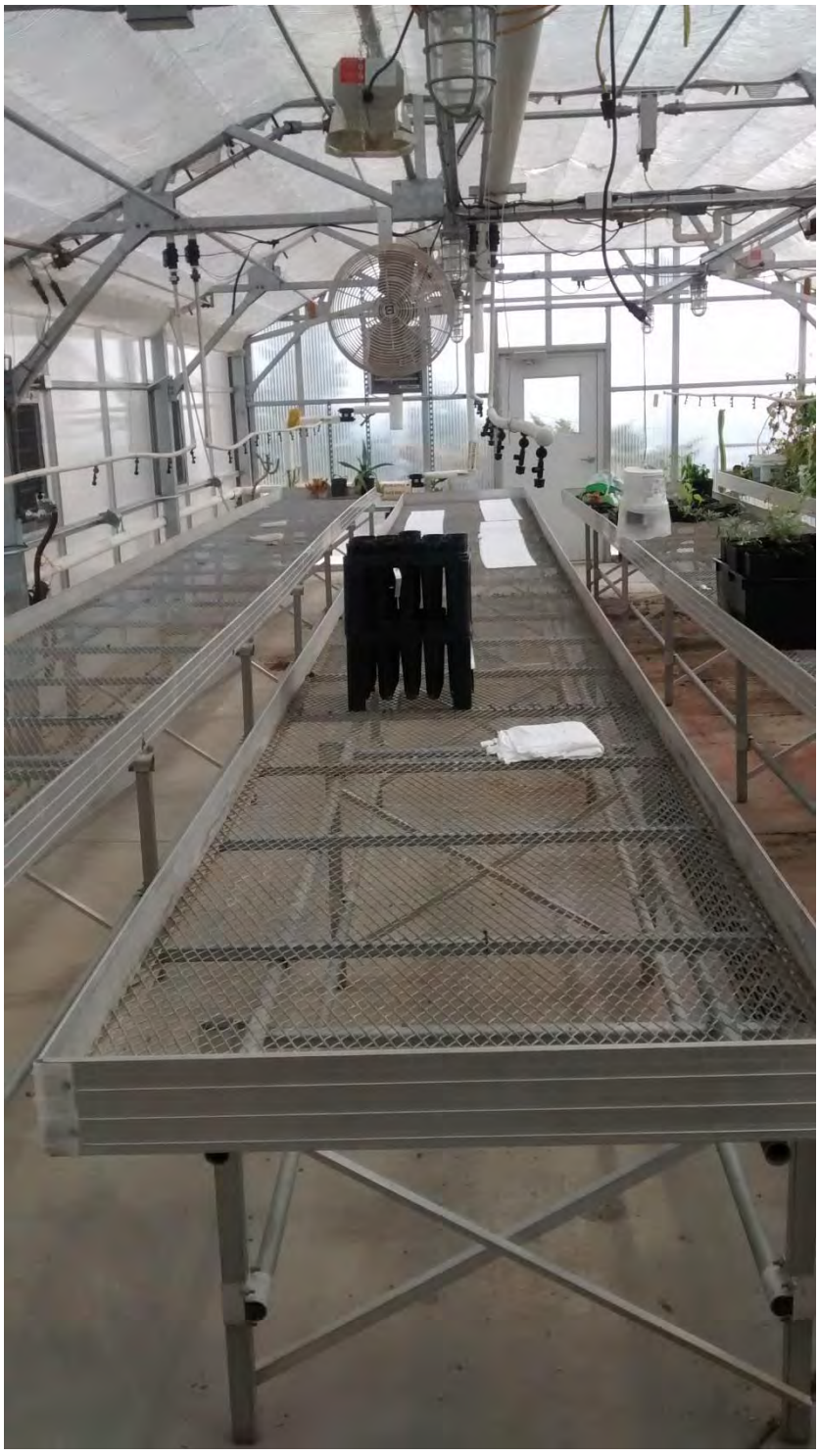

Photo 6. MT Tech greenhouse

Photo 7. Plants in inventory

Photo 8. Forb mats in production

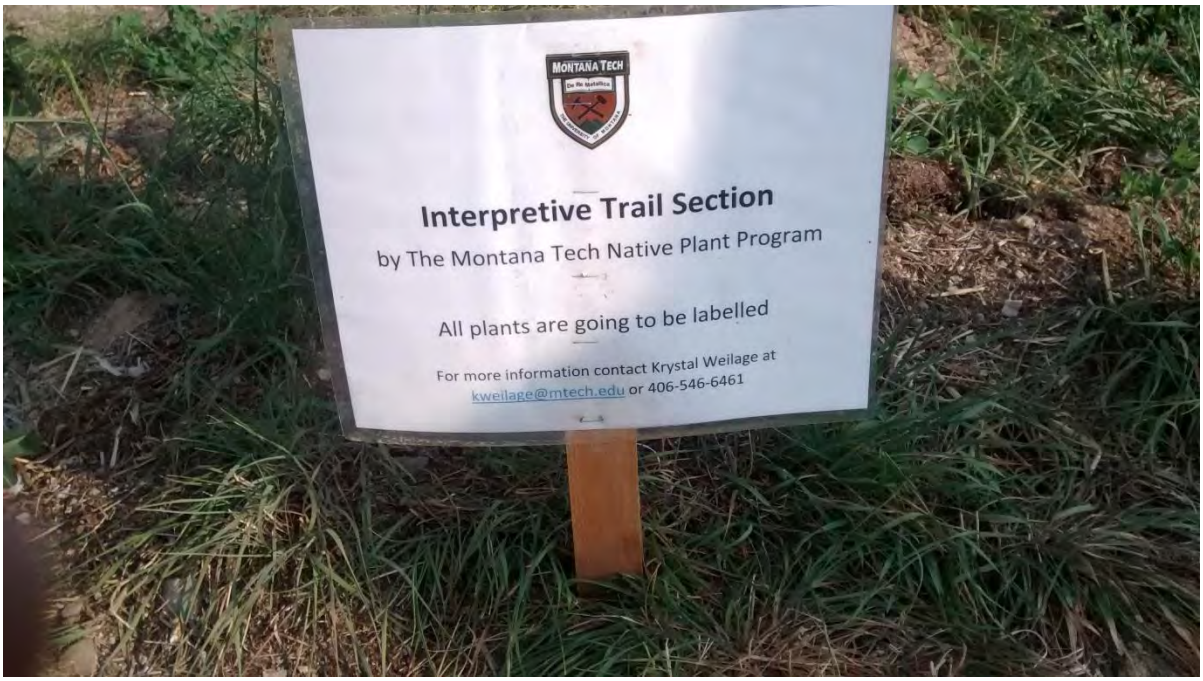

Photo 9. Stewardship efforts

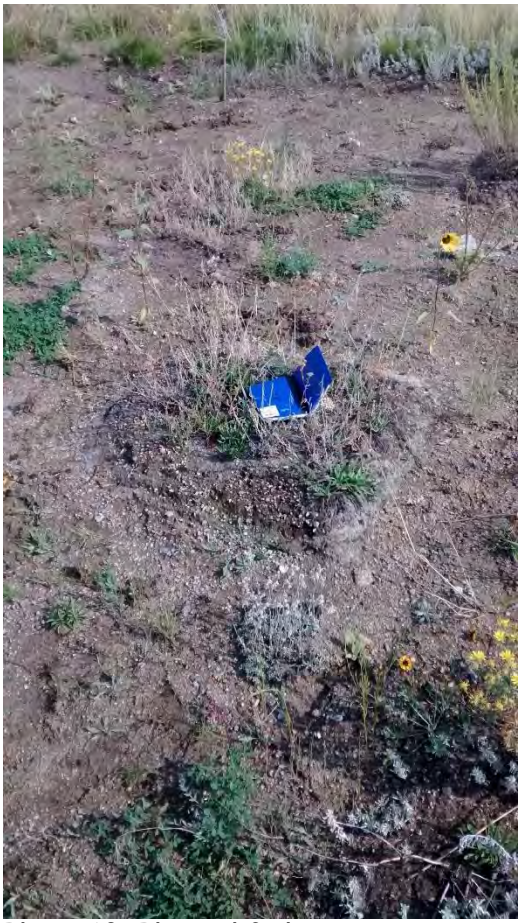
Photo 10. Planted forb mat

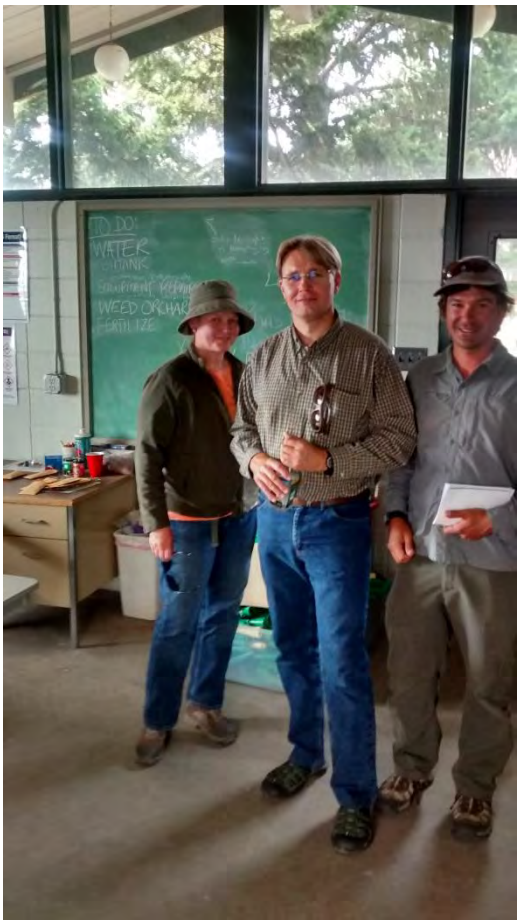
Photo 11. Dr. Pal, Crystal Weilage, Mark Mariano

Photo 12. Successful forb planting

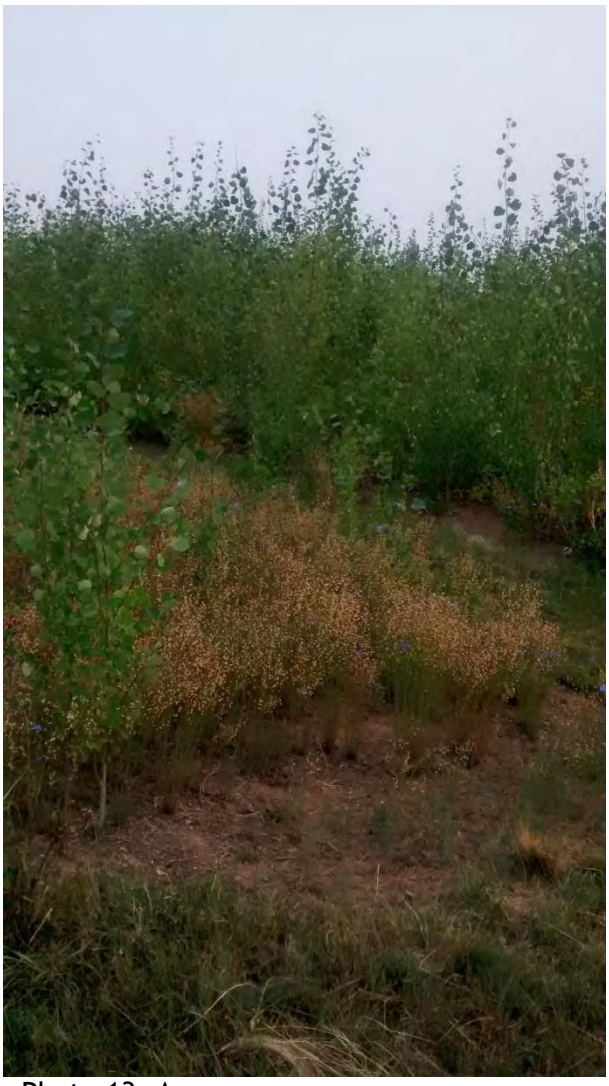

Photo 13. Aspen success

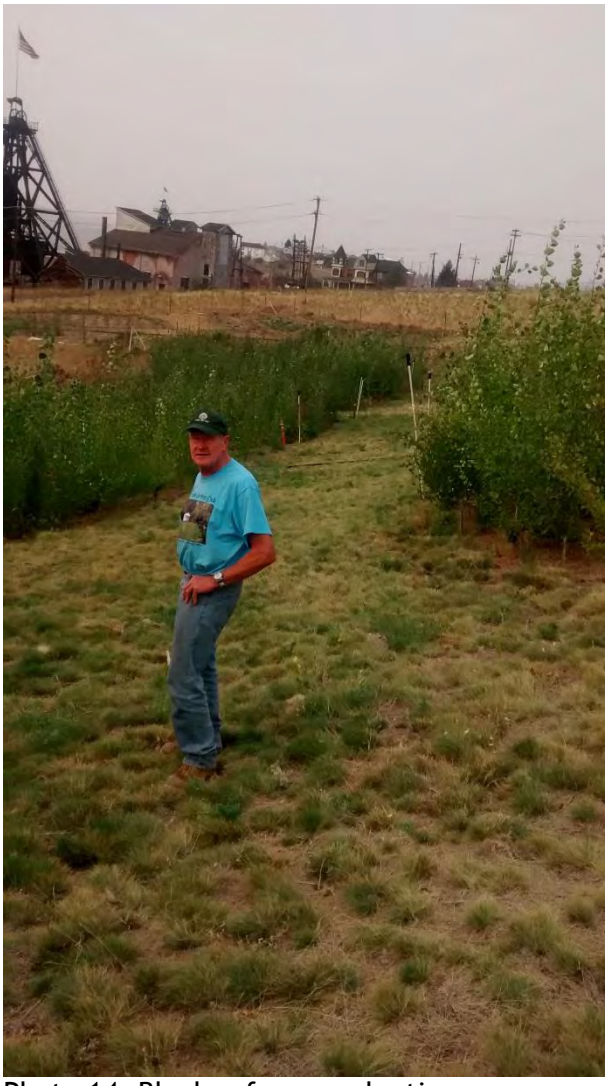

Photo 14. Blocks of aspen plantings

APPENDIX B

Revegetation/Restoration Resources

Native Plant Suppliers

CSKT Forestry Nursery
104 Main Street SE
Ronan, MT 59864
Matt Ogden (Horticulturist)
matthew@npsservicesllc.com
406-381-4647

Great Bear Restoration
165 Blue Heron Dr.
Hamilton, MT 59840
www.greatbearrestoration.com
406-239-1103

Westscape Nursery
110 Progressive Dr.
Belgrade, MT 59714
www.westscapenursery.net
406-388-1116

Natures Enhancement
2980 Eastside Hwy.
Stevensville, MT 59870
www.naturesenhancementninc.com
406-777-3560

Glacier Nursery
4343 Montana Hwy 35
Kalispell MT 59901
www.glaciernursery.com
406-755-2248

Montana Conservation Seedling Nursery
2705 Spurgin Road
Missoula, MT 59804
www.mtnursery@mt.gov
406-542-4244

Reclamation Equipment and Suppliers

Forestry Suppliers
www.Forestry-Suppliers.com
215-392-4395

Ben Meadows
www.BenMeadows.com

Tree stakes (below ground)

Tree Staple Inc.
www.treestaple.com
877-873-3749

Fertilizer packs, Mycorrhizal inoculum

Reforestation Technologies International
www.reforest.com
800-784-4769

Mycorrhizal Applications Inc.
www.mycorrhizae.com
866-476-7800

Weed Mats
www.tubexusa.com
800-255-1075

Browse repellents
www.plantskydd.com

Pocket gopher traps
www.VictorPest.com/Gopher

Native Plant Information and Revegetation Resources

Roadside Revegetation Handbook (This is an excellent resource!!!)
http://nativerevegetation.org/learn/

Deep-Planting Techniques to Establish Riparian Vegetation in Arid and Semi-arid Regions
Dreesen, DR, Fenchel, GA, USDA-NRCS, Native Plants Journal (2008)

Forest Nursery Notes, Fall 2002
USFS (2002)
http://www.rngr.net/publications/fnn
Native Plant Materials Directory
Native Plants Journal (2008)

Native Plant Revegetation Guide for Colorado
Colorado Natural Areas Program (1998)

NRCS Revegetation Guidelines-Appendix 7G
USDA-NRCS (2000)

Native Seed Stratification Time Table
McLaughlin, M, Robertson, N (2010)

Organic Fertilizer- Garden Notes #234
Colorado State University Extension- Colorado Master Gardener Program (2008)
http://www.cmg.colostate.edu/

The Practical Streambank Bioengineering Guide
Bentrup, D, Hoag, CJ (1998)

Reestablishing Natural Succession on Acidic Mine Spoils at High Elevation: Long-Term Ecological Restoration
Brown, RW, MC Amacher, WF Mueggler, J Kotuby-Amacher, USFS (2003)
http://www.treesearch.fs.fed.us/pubs/5590

Resource Road Rehabilitation Handbook: Planning and Implementation Guidelines
Moore, GD (1994)
http://www.env.gov.bc.ca/wld/documents/wrp/wrtc_3_part1.pdf

Riparian/Wetland Project Information Series No. 9: Design Criteria For Revegetation In Riparian Zones Of The Intermountain Area
Carlson JR, Conaway, GL, Gibbs, JL, Hoag, CJ. USDA-NRCS(1995)
http://plant-materials.nrcs.usda.gov/pubs/idpmcarwproj9.pdf

Riparian/Wetland Project Information Series No. 19: Simple Identification Key to Common Willows, Cottonwoods, Alder, Birch, and Dogwood of the Intermountain West
Hoag, CJ, USDA-NRCS (2005)
http://plant-materials.nrcs.usda.gov/pubs/idpmcar6107.pdf

Riparian/Wetland Project Information Series No. 20: How to Collect and Use Wetland Sodmats
Hoag, CJ, USDA-NRCS (2008)

Plant Materials No. 4 October 2002: Reading Seed Packaging Labels and Calculating Seed Mixtures
Hoag, CJ, St. John, L, Ogle, DG (2002)
Plant Materials No. 6: The Stinger - A Tool To Plant Unrooted Hardwood Cuttings
USDA-NRCS (2008)

Plant Materials No. 23: How To Plant Willows And Cottonwoods For Riparian Restoration
Hoag, CJ, USDA-NRCS (2007)
http://199.134.172.30/ftp/ID/programs/technotes/planting_willowsa.pdf

Planting Tools for Restoration
Kloetzel, S., Native Plants Journal (2004)

Willow Clump Plantings
Hoag, CJ, USDA-NRCS (2003)
ftp://ftp-fc.sc.egov.usda.gov/ID/programs/technotes/willow_clump1.pdf