NEWSOME CREEK, IDAHO: REVEGETATION PLAN FOR A FLOODPLAIN IMPACTED BY HISTORIC DREDGE MINING[1]

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Abstract. Restoration of riparian vegetation is critical for improving water quality and healthy fisheries on streams that have been impacted by mining activities. Woody riparian plants provide bank stability, shade for temperature moderation and woody debris for fish habitat. Mining wastes (dredge piles) that are distributed across the valley floor along Newsome Creek confine the stream to a narrow, drastically disturbed channel which limits the potential for natural channel migration and reduces areas of productive aquatic habitat. The Nez Perce National Forest and the Nez Perce Tribe are undertaking a watershed rehabilitation project involving road decommissioning and stream restoration. Ecosystem Research Group and Herrera were hired to design the channel and floodplain restoration for a 3.5-mile section of Newsome Creek. Geomorphologists, engineers, fisheries biologists, and riparian ecologists collaborated to design channel and floodplain improvements and fish habitat structures. Goals of the restoration project are to design a self-sustaining channel that will neither aggrade nor degrade, restore native riparian vegetation, and reestablish connectivity between the channel and floodplain. Channel design focuses on opportunities to restore natural channel migration processes. Revegetation design includes site specific prescriptions for the streambank, re-graded floodplain, and relocated tailings piles. Challenges for revegetation included coarse-grained soils lacking in organic matter and a very short growing season. The planting plan incorporates detailed prescriptions for container sizes, plant species, seed mixes, and seeding methods as well as specific methods for salvaging existing native vegetation. Container depths are specified to ensure that plant roots will have access to the water table. Plant and seed mix selections are based on site adapted species, taking into account plant availability to avoid last-minute problems with supply. Planting is scheduled to occur over a two to three year period starting in 2011. Following construction, the project includes extensive long-term monitoring to determine revegetation success.

Additional key words: revegetation, reseeding, dredge tailings, riparian, floodplain, fish habitat, stream restoration

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Introduction

Restoration of riparian vegetation is critical for improving water quality and healthy fisheries on streams impacted by mining activities. Streamside vegetation buffers streams from temperature changes and sediment, provides organic material to the stream for food web support, is a source of woody debris for fish habitat and helps maintain stable streambanks. Mining wastes (dredge piles) are distributed across the valley floor along Newsome Creek confining the stream to a narrow, drastically disturbed channel and limiting the potential for natural channel migration and reducing areas of productive aquatic habitat. The Nez Perce National Forest (NPNF) and the Nez Perce Tribe (NPT) are undertaking a watershed rehabilitation project involving road decommissioning and stream restoration. Ecosystem Research Group and Herrera were hired to design the channel and floodplain restoration for a 3.5-mile section of Newsome Creek. This paper presents the revegetation portion of the restoration plan, focusing on methods for addressing the challenges of successfully re-establishing native riparian vegetation on the streambanks and floodplain.

Background

Site description

The Newsome Creek watershed encompasses 17,250 hectares on the Nez Perce National Forest in north-central Idaho; approximately 12 air miles northwest of Elk City, Idaho (see Fig. 1). The entire watershed lies within the ceded lands of the Nez Perce Tribe. Newsome Creek is a fifth-order tributary of the South Fork Clearwater River. The main stem is approximately 15.7 miles long. The headwaters of Newsome Creek originate at 1,524 meters above mean sea level and flow southerly to 1,106 meters above mean sea level near the mouth (USFS 2006 EIS). Average bankfull width in the project area is is 7.2 meters (ERG and Herrera 2007) .

Stream gaging data is not available on Newsome Creek, so three statistical methods were used to estimate magnitudes of flood flows on comparable watersheds in close proximity to the Newsome Creek watershed. Two-year return interval flow estimates are 156 to 228 cubic feet per second (cfs) at the lower end of the project area and 68 to 81 cfs at the upper end (ERG and Herrera 2007).

The restoration project area is divided into six project reaches (see Fig. 2). The approximately 3.5 mile length of Newsome Creek to be rehabilitated is located from just above the confluence of Baldy and Pilot creeks upstream to the confluence with Radcliff Creek.

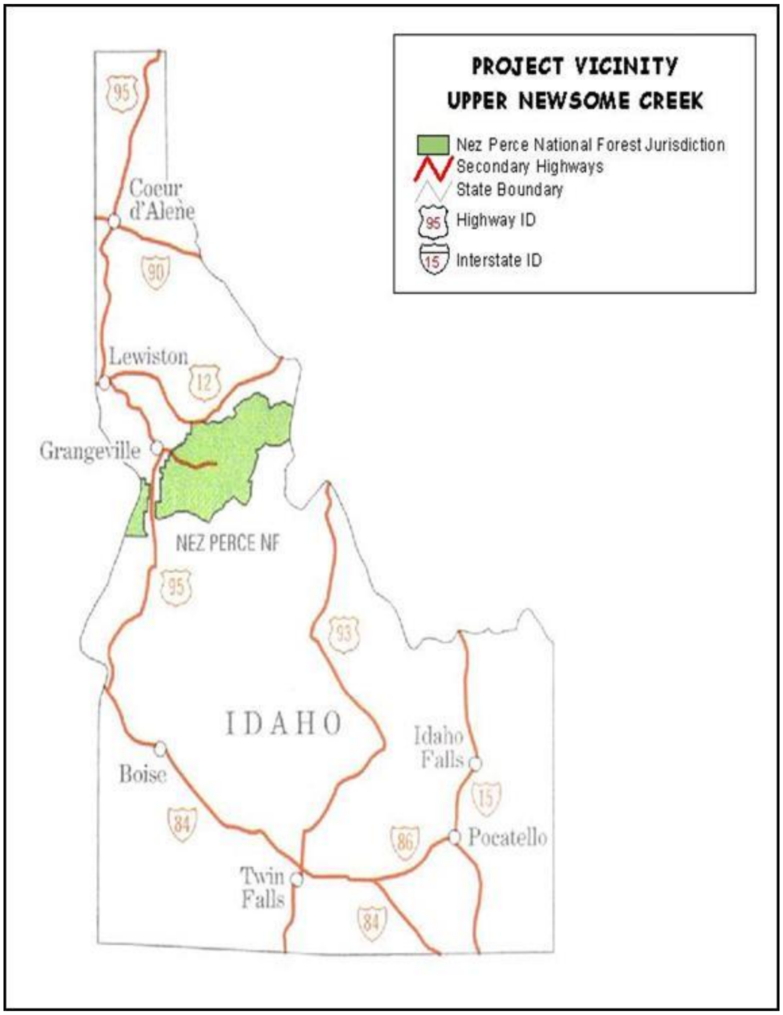

Figure 1. Newsome Creek vicinity map (Source: CCH 2004)

The upper Newsome Creek watershed consists of a low gradient alluvial stream corridor framed by high-relief timbered slopes. Moist timbered meadows alternate with naturally confined, thickly timbered slopes, and occasional broad alluvial valleys, with an abundance of grasses, sedges, and forbs.

Current Newsome Creek channel types in undisturbed reaches are likely similar to those of presettlement periods. However, major human-induced disturbances, primarily dredge mining activities, have affected stream and riparian processes, resulting in some changes in channel type within the watershed (Ecovista and Nez Perce Tribe 2002). Mining activities have transformed these areas from sinuous streams with well developed floodplains typically found in alluvial deposition to less sinuous, higher gradient streams with limited floodplain development (USFS 2006).

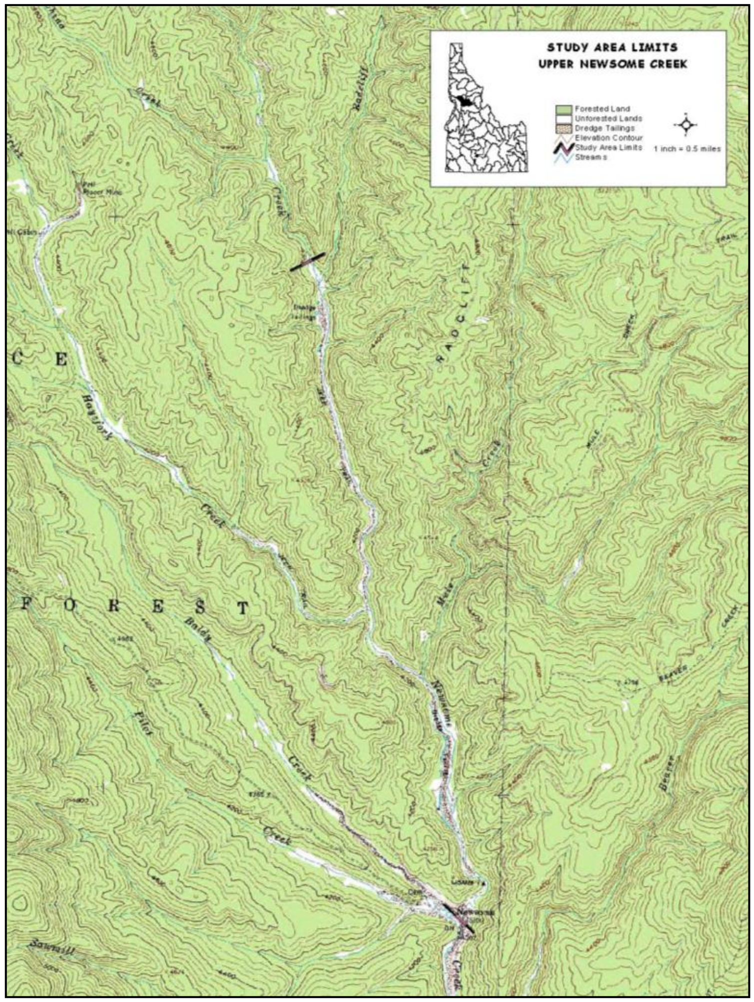

Figure 2. Newsome Creek reach breaks (Source: CCH 2004)

Within the Newsome Creek stream restoration project area, the stream substrate has been characterized as very coarse gravel embedded with fine sand that is covered by a surface layer of loose angular rock/large cobble that moves with high flow every year. Wolman pebble counts indicate more than the desirable quantities of fine sediment within spawning gravels in the stream restoration project area (USFS 2006).

Roughly one fourth of all stream length in the Newsome Creek watershed is of sufficient gradient (not necessarily sufficient habitat quality) to provide aquatic habitat for anadromous species that migrate from the sea to fresh water (chinook and steelhead). Low gradient (<2%) reaches accessible to both species are primarily restricted to the mainstem of Newsome Creek, Baldy Creek, and the lowermost reaches of the West Fork, Newsome, Beaver, Pilot, and Sawmill creeks. The relatively limited distribution of suitable habitats for anadromous species within the Newsome Creek watershed underscores the importance of protecting, maintaining, and/or enhancing those habitat areas for the benefit of salmonid (particularly anadromous) species.

Climate

The Newsome Creek watershed is typical of the region, with a short growing season, dry summers, and a snow-melt dominated hydrograph. Annual precipitation in the watershed ranges from about 75 centimeters at the lower elevations to about 125 centimeters at the higher elevations. About 50% of the annual precipitation occurs from November through March, much of it in the form of snow. The wettest months are December and January, though May and June are also relatively wet due to a combination of frontal and convective storms. The driest months are July and August, respectively. In eight years out of ten during the growing season, temperatures can be expected to be above freezing for only eleven consecutive days (Ecovista and NPT, 2002).

Soils

The valley bottoms of the Newsome Creek watershed contain alluvial deposits derived from the residual rock, Tertiary sediments, and a surface layer of volcanic ash from about 6,700 years before present. In areas impacted by historical mining mostly only coarse sediments remain (USFS 2006), therefore soil compaction is not a concern in the project area.

Current land management

The Newsome Creek restoration project area is managed for high quality fish and wildlife habitat and water quality and to provide opportunities for high quality, semiprimitive, dispersed recreation (Ecovista and NPT, 2002).

History and impacts of mining

Placer mining has directly affected the form and function of stream channels throughout the western United States by disrupting the natural stream bed and bank structure, increasing sediment and channel mobility and altering the flow regime if diversion occurs. The disruption of bed and bank sediment renders the sediment more susceptible to being moved by the river flow. Fine-grained sediment is preferentially mobilized from the disturbed area and accumulates downstream. The river at the mining site can remain unstable for decades after mining has ceased because the fine grained bank sediment that once supported stabilizing riparian vegetation is gone (Wohl, 2005).

Newsome Creek was dredged in the late 1930s through 1942 (USDA, 1970). In places the floodplain was filled with tailings to a depth of 60 meters (Ecovista and NPT, 2002). An unknown volume of gravels were dredged during those years. Recent estimates indicate there are approximately 65,000 cubic meters of dredge wastes on the valley floor within the project reach (CCH, 2004).

Historical dredge mining operations have drastically altered the valley by fractionalizing and isolating much of the floodplain and riparian zone, dramatically altering channel morphology (see Fig. 3). Stream sinuosity has been significantly reduced, homogenizing many sections into long, channelized riffles. In addition aquatic habitat conditions including the size and frequency of pools, large woody debris presence/recruitment, and bank stability have been degraded. Activities to promote pool formation, sediment sorting, and grade control have been implemented by the NPNF and the NPT with some success, although the major morphologic and riparian changes caused by dredge mining persist (CCH, 2004).

Figure 3. Newsome Creek mine tailings (Source: CCH 2004)

Riparian vegetation

In the Newsome Creek stream restoration project area, it is estimated that well over half of the riparian influence zone has been affected by dredge mining waste, and vegetative cover and shade is lacking throughout the project area. The condition of riparian vegetation is substantially reduced in dredged versus undredged stream segments (Ecovista and NPT, 2006). The poor condition of riparian vegetation in the affected stream segments has negative impacts on stream temperature, bank stability and woody debris recruitment. Although no baseline studies were conducted on macroinvertebrate populations, the assumption is that reduced organic matter inputs due to degraded riparian vegetation adversely impacts aquatic invertebrate numbers and diversity.

The general condition of the riparian corridor in Reach 01 and Reach 06 is excellent and comparable to undisturbed stream reaches above the stream restoration project area. Upland species include grand fir and lodgepole pine in Reach 01 and Douglas-fir and lodgepole in Reach 06. Herbaceous species, including grasses, sedge, wildflowers, and forbs, are prevalent directly adjacent to the stream in both reaches, although Reach 01 has a higher component of moist shrubs including water birch, alder, red osier dogwood, and willow (CCH 2004). These stream reaches provide a reference for restoring floodplain vegetation along affected areas of the stream.

Project goals

The Newsome Creek channel and riparian habitat design project is part of a series of restoration and recovery projects in the Clearwater basin for federally listed and Forest Service sensitive fish species. Newsome Creek contributes significantly to the upper South Fork Clearwater River's ability to support listed anadromous and resident fish species. This watershed is a high priority for restoration because of its high potential aquatic productivity, intact aquatic assemblages, and current conditions and processes affected by past management (Ecovista and NPT, 2002).

The NPNF has multiple goals for this project including designing a self-sustaining channel that would neither aggrade nor degrade, restoring native riparian vegetation, and reestablishing connectivity between the channel and floodplain. These goals would improve the aquatic habitat and overall stream and riparian condition and function in upper Newsome Creek. The project is designed to achieve these goals by 1) selective regrading of tailings dredge piles; 2) increasing channel length through the addition of meanders; 3) adding structures with multiple purposes such as habitat improvement and facilitation of channel movement; and 4) revegetating the floodplain with native riparian species (ERG and Herrera, 2008).

The stream channel design was created to specifically address increasing morphologic diversity and enabling the channel to use its own fluid hydraulics to create bedforms, modify its boundary, and sort sediment. The design provides the means for habitat-forming processes to work by regrading 2.23 hectares (approximately 16,820 m^3) of tailings, constructing approximately 282 m of new channel, and adding and modifying existing instream habitat structures. Tailings regrading allows the channel to regularly inundate the floodplain and facilitate the development of streamside vegetation. Additional channel length decreases channel slope to allow spawning gravels to be retained, and the addition of habitat structures increases the complexity of hydraulic flow patterns to develop bedforms and sort sediment (ERG and Herrera, 2008).

The revegetation plan, which is the subject of this paper, focuses on use of native herbaceous and woody vegetation, and the appropriate techniques to address the challenges of the site and ensure plant survival.

Challenges for revegetation

The goal of reclaiming riparian floodplains negatively affected by placer mining is often not met because even the best designed reclamation grading does not correct major, long-term changes in the riparian ecosystem caused by placer mining. Changes which are likely to affect many aspects of ecosystem function and plant community structure include elevation of spoil above the active floodplain and soil loss (Densmore, 1994).

Deposition of the mine spoil above the active floodplain elevates the surface above the hydrological conditions that created the original floodplain environment. Although old terrace and channel areas were above the active floodplain before mining, their plant communities and soils were initiated when those areas were close to the water table and subject to flooding and sediment deposition. Furthermore, the elevation is increased relative to pre-mining conditions because the volume of the excavated gravel is approximately one-third greater than the original volume (Densmore, 1994).

The second change, soil loss, includes not only topsoil loss but also loss of fines (soil-sized particles, $\leq$2mm) and organic material which are washed from alluvial gravels during processing (Densmore, 1994).

In addition to these challenges, the short growing season, summer drought, weeds and browsing animals need to be addressed to ensure successful revegetation.

Design features to address challenges

Grading

Regrading the stream channel will allow the channel to regularly inundate the floodplain which will facilitate the development of streamside vegetation. The areas where dredge piles are to be re-graded and the locations of repositories for the tailings dredge piles were identified and reviewed in the field with the Forest Service on November 14, 2007. Based on input from that meeting, individual regrading area locations were mapped using GPS.

The design includes two types of regrading. One consists of removing dredge piles down to the floodplain elevation and placing the materials in designated nearby repository areas. Actual grading elevations will vary to preserve existing mature vegetation to the extent possible. The second type of grading consists of leveling dredge piles locally. The majority of the grading and leveling is expected to occur using a bulldozer to minimize costs. In sensitive areas near the creek, near mature vegetation or wetlands, a hydraulic excavator will move the tailings away from those areas before being moved by the bulldozer. Where feasible, woody vegetation will be salvaged and transplanted. Trees that are removed during grading will be utilized for constructing instream habitat structures or remain on the floodplain to provide habitat. Floodplain grading should result in varied microtopography to provide a range of soil moisture (ERG and Herrera, 2008).

Soil Improvement

There are relatively few possibilities to salvage fine textured soils in the project area. The greatest potential is fine-grained sediment from the dredge ponds within repository areas. An additional source is soils that were stockpiled during past mining operations. These soils contain more nutrients and have higher moisture holding capacity than the coarse gravelly soils present on most of the site. These salvage areas were identified and incorporated into the floodplain regrading design. Salvaged soil will be spread out after the pile removal process is finished and the final grade is established.

Placement of borrowed soils will be done by the construction contractor in order to minimize transportation costs. The possibility of importing topsoil was considered, but was determined to be cost-prohibitive due to the hauling expense.

Revegetation

The revegetation plan for Newsome Creek focuses on the use of native herbaceous and woody vegetation. Seeds and cuttings will be collected in 2010 from a similar elevation and in close proximity to the Newsome Creek drainage. Plants will be container-grown and treated with appropriate mycorrhizal inoculum either in the nursery or at the time of planting. Woody species are specified in appropriate container sizes to further increase rates of survival. Planting will be phased over a two to three year period beginning in 2011 as regrading is completed on each segment of the project. Seedlings will be planted in early spring before breaking dormancy or in fall after September 15th and before November 1.

The co-author’s past experience has shown that floodplain planting projects using willows commonly use containers with insufficient depth to access soil moisture as the water table drops in the first season after planting. Due to willows' low drought tolerance, the revegetation plan calls for the use of 14-inch deep containers to addresses this problem and lead to a much higher survival rate than the typical 10-cubic inch or one-gallon containers. Conifers and other shrubs can tolerate low moisture conditions and do not need deep planting containers.

A study of succession on re-graded placer mine spoil in Alaska showed that addition of time-release, N, P, and K fertilizer significantly increased vascular and non-vascular plant cover and the growth rate of the naturally colonizing willows relative to controls (Densmore, 1994). A follow-up study indicated that a temporary lack of mycorrhizae contributed to the need for fertilizer. Development of mycorrhizal associations was delayed on cutting roots in this study for one to two growing seasons (Densmore and Karle, 1999). The Newsome Creek revegetation plan specifies that plants should be inoculated with mycorrhizae in the nursery (preferred method), or “Time of Planting” inoculum placed in planting holes, and that Biosol or a similar slow-release organic soil amendment should be spread on the site at a rate of 1000 lbs per acre. Organic soil amendments are insoluble and depend on microbial action to release nutrients, therefore reducing the potential for leaching or nutrient runoff.

Planting zones

The Newsome Creek revegetation plan divides the project into three planting zones; the streambank, the re-graded floodplain, and the relocated tailings piles (hereafter referred to as the valley floor). Plantings along the streambank will consist of containerized alder and willows planted along both sides of the channel. Plantings in the re-graded floodplain will consist of seeding and containerized shrub and conifer plantings. The seed mix will consist of native species with the addition of Regreen (a sterile hybrid grass) to provide rapid cover. The containerized plants will be planted in natural appearing patches. Willows and alders will be placed in moist depressions, and the remaining plants will be placed in drier areas. Plantings on the valley floor will consist of the same seed mix as the floodplain. Shrub and conifer species for each zone are listed in Table 1. Seeded species are listed in Table 2.

Seeding method

Seeding will take place after the floodplain has been re-graded, tailings piles have been moved, and woody debris has been placed in the floodplain. The seeding plan takes into account the different light and moisture requirements of the various species. The lupine seed will be planted in scattered patches and buried at least ½ inch deep by raking to cover the seeds. The yarrow and grass seed will be hydromulched and fireweed will be hand broadcast on top of mulch in the moister areas. All seed will be specified as free of all state of Idaho noxious weeds.

Plant preservation and salvage

Salvaged alder and willow clumps from the floodplain re-grading and new channel construction will be incorporated into the habitat enhancement structures where possible by burying the root systems into the habitat structures as they are being constructed. In addition salvaged plants will be planted in floodplain sites with consistent soil moisture. If possible, salvage and placement will be done when plants are dormant. Where feasible, mature grand fir and spruce trees in the floodplain will be marked as “leave trees” before channel reconstruction begins to provide shade until the planted vegetation becomes established. The bases of the trunks must not be buried during re-grading activities. During construction, mats of wetland sedges in the area between tailings piles will be salvaged and immediately replanted on areas where grading is complete and soil is consistently moist.

Table 1. Plant species for Upper Newsome Creek revegetation plan.

Streambank	
Mountain alder	*Alnus incana spp tenuifolia*
Sandbar willow	*Salix exigua*
Drummond willow	*Salix drummondiana*
Geyer willow	*Salix geyeriana*
Floodplain	
Lodgepole pine	*Pinus contorta*
Engelmann spruce	*Picea engelmannii*
Douglas-fir	*Pseudotsuga menziesii*
Drummond willow	*Salix drummondiana*
Geyer willow	*Salix geyeriana*
Streambank willow	*Salix exigua*
Woods rose	*Rosa woodsii*
Snowberry	*Symphoricarpos alba*
Swamp gooseberry	*Ribes lacustre*
Valley Floor	
Lodgepole pine	*Pinus contorta*
Douglas-fir	*Pseudotsuga menziesii*
Woods rose	*Rosa woodsii*
Snowberry	*Symphoricarpos alba*
Swamp gooseberry	*Ribes lacustre*

Table 2. Streambank and Floodplain Seed Mix.

Yarrow	*Achillea millefolium*
Fireweed	*Epilobium*
Silvery Lupine	*Lupinus argenteus*
Columbia	*Bromus vulgaris*
Bluejoint	*Calamagrostis*

Plant protection

Browse netting will be installed using individual 3-inch diameter, 2-foot tall tubes for 10 cubic inch plants, and 6 to 8 inch diameter, 4 foot tall browse protectors for 14-inch deep plants (willows).

Weed control

Two Idaho state listed noxious weeds (ISDA, 2009) occur on the site including oxeye daisy (*Chrysanthemum leucanthemum*) and Canada thistle (*Cirsium arvense*). Oxeye daisy occurs throughout the site but does not appear to be out-competing the native vegetation. There are minor amounts of Canada thistle on the project site. Common tansy (*Tanacetum vulgare*) also occurs on the site in minor amounts. If feasible, these weeds will be treated with herbicide by a licensed applicator prior to ground disturbing activities to reduce their spread.

Spotted knapweed (*Centaurea stoebe*, formerly called *Centaurea maculosa*) occurs on the main Newsome Creek road. This weed is also on the Idaho noxious weed list. Construction equipment should be washed prior to entering the project site to minimize the potential to introduce this species. If plants are in flower when construction begins, the area should be mowed prior to equipment entering the area.

A major weed on the site is reed canarygrass (*Phalaris arundinacea*). Although not a state listed noxious weed, reed canarygrass can hinder the establishment of native grasses, forbs and shrubs through competition for light and water. Weed mats will be used around planted vegetation to suppress this species.

Monitoring and maintenance

Survival monitoring and plant replacement during the first year after planting will be the responsibility of the planting contractor. After the first year, monitoring and replanting if necessary will be the responsibility of the NPNF. Monitoring of revegetation success will continue for 3 – 7 years because of the time it takes for effects on vegetation such as soil and weather conditions, elk and moose browsing and beaver activity to become apparent. Areas that are not successfully revegetated will be reseeded (grasses) and replanted (trees and shrubs). Monitoring will include vegetation sampling, documenting weed infestations, documenting browse damage, and recommendations to correct any problems observed. Browse protectors will be removed after three years or after sufficient plant growth has occurred.

Fish population surveys will be conducted by the NPT and the NPNF after project completion to provide information on the effectiveness of this project in restoring salmonid populations.

Conclusions

The Newsome Creek restoration and revegetation project offers an opportunity for a multidisciplinary approach that incorporates revegetation prescriptions into the overall channel and habitat restoration designs. The successful establishment of riparian vegetation is crucial to achieving the goals of re-establishing natural flooplain processes. The channel and floodplain design focus on targeted use of re-grading and plantings, and preservation of existing vegetation to the greatest extent possible to arrive at the most cost-effective means of restoring high quality fish habitat in this section of Newsome Creek. This design incorporates lessons learned from past experience, supported by the scientific literature, to develop a design that will re-establish riparian vegetation to speed the recovery of natural floodplain processes.

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