Rocky Mountain
Field Institute

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Pikes Peak Watershed Erosion Control and Restoration Project: Severy Creek Wetland and Ski Creek Preliminary Proposal (DRAFT)

El Paso and Teller Counties, Colorado
Pike National Forest

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CONTENTS

CHAPTER

1. INTRODUCTION and BACKGROUND 4

1.1 Severy Creek Wetland 7

1.2 Ski Creek 9

2. SEVERY CREEK WETLAND PROJECT AREA 12

2.1 Proposed Action- Phase 1: Stabilization of Gully Channels 14

2.1.1 Alternatives to Proposed Action- Phase 1 16

2.2 Proposed Action- Phase 2: Stabilize Alluvial Fan 20

2.2.1 Alternatives to Proposed Action- Phase 2 22

2.3 Proposed Action- Phase 3: Restoration of Wetland. 23

2.3.1 Alternatives to Proposed Action- Phase 3 24

3. SKI CREEK PROJECT AREA 25

3.1 Proposed Action- Phase 1: Stream Reconstruction 28

3.1.1 Alternatives to Proposed Action- Phase 1 29

3.2 Proposed Action- Phase 2: Restoration of Original Channel 29

3.2.1 Alternatives to Proposed Action- Phase 2. 30

3.3 Proposed Action- Phase 3: Restoration of Snowmaking Pond. 33

3.3.1 Alternatives to Proposed Action- Phase 3 34

BIBLIOGRAPHY 35

Forward

This report introduces the various issues surrounding restoration work proposed within the Severy Creek and Ski Creek basins located on Pikes Peak, Colorado. Information included in this report was prepared to assist in the development of an Environmental Assessment to describe possible environmental impacts resulting from implementation of the proposed actions and alternatives described within. Final designs and monitoring and evaluation plans are not included. This report should be considered preliminary and no final decisions on the actions to be implemented should be inferred.

INTRODUCTION AND BACKGROUND

Pikes Peak, renowned as America's Mountain, is located west of Colorado Springs (Lat. 38° 50' 26" N, Long. 105° 02' 38" W) and reaches a height of 14,110 feet. The peak is one of the principal landmarks in the western United States and provided inspiration for the song "America the Beautiful." The peak has long been a key recreational resource and is presently the second most visited mountain in the world after Japan's Mount Fuji. In addition to the 15,000 hikers who climb the peak each year, over 300,000 visitors arrive at the summit via the Pikes Peak Highway; a 19-mile toll road, operated year-round by the City of Colorado Springs. The highway is the site of the legendary Pikes Peak Hill Climb, one of the most famous and oldest car races in the United States. Pikes Peak is also one of the most important natural areas in the region. The mountain provides habitat for a wide range of native flora and fauna including populations of the federally threatened Colorado greenback cutthroat trout. In addition, the Pikes Peak Watershed is a principal local source of water for the communities of Colorado Springs and Manitou Springs.

Automobile use of the Pikes Peak Highway began in 1915. Since then, over ninety years of uncontrolled stormwater runoff from the highway into sensitive wetland and riparian areas of the Pikes Peak Watershed have caused severe environmental impacts due to extreme erosion and sedimentation. Over 110 drainage gullies have been identified within the watershed that are directly connected with stormwater runoff from the highway (RMFI, 2003). These drainages range from relatively shallow conveyance channels to behemoth gullies 20 feet deep and 20 to 30 feet wide. The sediment eroded from the creation of these channels and the sediment conveyed through them during storm events has inundated wetlands and in-filled valley floors. This sediment is choking area streams and negatively affecting the aquatic life dependant upon them.

As early as 1952, nearly a dozen reports and studies from several organizations and agencies have confirmed the environmental degradation caused by the highway upon the surrounding landscape within the Pikes Peak Watershed. In 1999, an Environmental Assessment report conducted for the Pikes Peak Highway Drainage, Erosion and Sediment Control Plan concluded that:

"Use and maintenance of the Pikes Peak Highway has altered the hydrology of many of the adjacent drainage basins. This has occurred as a result of changes to natural infiltration rates, extension of the drainage network and redirection of natural flow pathways. The sediment regime of the system has also been significantly altered as a result of additional sediment loading from the erosion of cut slopes and the road, and maintenance activities (e.g. sidecasting of gravel). [The highway] requires regular and frequent resurfacing with gravel, much of which leaves the highway corridor. Gravel and sediment that leaves the highway is deposited in alluvial and in-valley fans, wetlands, stream channels near the highway corridor, or is transported and deposited in downstream areas further away from the road. The results of sediment deposition in these areas have included negative impacts to aquatic, wetland and tundra habitats, and the loss of channel stability and cross sectional area" (Hydrosphere Resource Consultants, 1999, p. 4).

The preferred plan in the Environmental Assessment recommended that measures put forth in a 1995 study commissioned by the City of Colorado Springs and designed by the Drexel Barrell & Company in 1997 be implemented with minor changes. This report (*Drainage, Erosion and Sediment Control Plan and Preliminary Road Design for the Pikes Peak Highway)* concluded that the stormwater runoff from the highway urgently needed to be addressed and recommended that erosion control structures (e.g. sediment ponds/traps, rock weirs, etc.) be placed at discharge points and that the highway itself undergo road stabilization (paving).

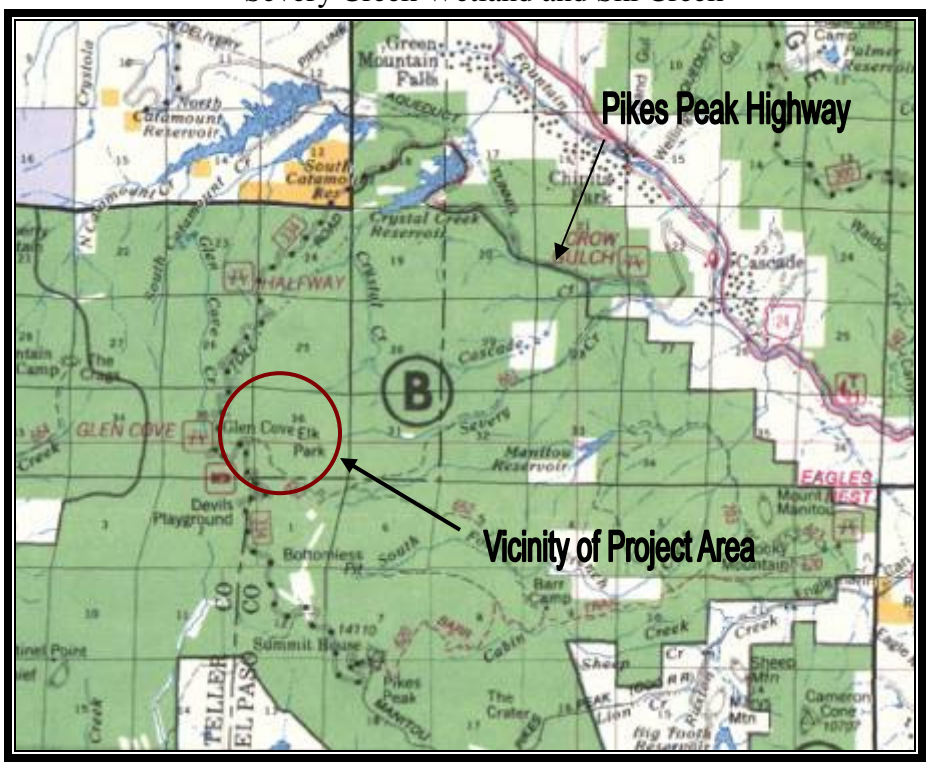
Paving operations and the construction of erosion controls within the Pikes Peak Highway corridor began in 2001 when the City of Colorado Springs implemented the Pikes Peak Highway Erosion and Sediment Control Plan (Knight Piesold Consulting, 2000). This plan separates the highway corridor into seven basins, with work being conducted in only one basin at a time. Currently work has been completed in Basin's 1, 2, and 3. Completion of the Pikes Peak Highway Erosion and Sediment Control Plan is expected in 2012.

It is important to note that the erosion and sedimentation impacts found outside the 300' highway corridor are not addressed by the Pikes Peak Highway Erosion and Sediment Control Plan. While the improvements being made to the highway will substantially help in reducing stormwater discharge and sediment transport in most areas,

many of the gullies that have developed are extremely unstable and will likely continue to degrade without erosion control prescriptions applied within the gullies themselves. In addition, many wetland areas are so aggregated that the removal of accumulated gravel material will be necessary to bring the wetlands back to a functioning state. The Pikes Peak Watershed Erosion Control and Restoration Project will address the severe erosion and sedimentation impacts that have occurred in two distinct drainage basins within the Pikes Peak Watershed. These basins include Severy Creek and the Severy Creek Wetland and Ski Creek and its adjacent wetlands.

Vicinity Map

Pikes Peak Watershed Erosion Control and Restoration Project:
Severy Creek Wetland and Ski Creek



Pike National Forest, Pikes Peak Ranger District
Portion of Section 35 & 36, T. 13 S., R. 69 W., 6th P.M., Teller, Colorado
Pike National Forest Map, 1992

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Map Created by: J. Hovermale 1/20/2006
Revised by: E. Billmeyer 11/10/2006

1.1 Severy Creek Wetland

The Severy Creek Wetland is one of the largest wetlands found on the Pikes Peak massif and is classified as a peatland. Wetlands in Colorado consisting of peat take an extremely long time to develop, only 20cm of depth for every 1000 years. Therefore the Severy Creek Wetland has probably required millennia for its creation (Cooper, 1998). In addition to the incalculable value of the wetland, the Severy Creek Watershed has also been classified as part of the Pikes Peak Potential Conservation Area (PCA), a region of outstanding biodiversity significance, by the Colorado Natural Heritage Program (CNHP) (Fayette, 1999). Seven rare plants as defined by the CNHP are found in the Pikes Peak PCA (Table 1).

Scientific Name	Common Name	Global Rank	State Rank
Oreoxis humilis	Pikes Peak spring parsley	G1	S1
Draba exunguiculata	clawless draba	G3	S3
Aquilegia saximontana	Rocky Mountain columbine	G3	S3
Draba fladnizensis	arctic draba	G4	S2S3
Telesonix jamesii	James' saxifrage	G4	S2
Mertensia alpina	alpine bluebell	G4	S1
Papaver lapponicum ssp. occidentalis	alpine poppy	G4T5	S2

Table 1. Plants identified as rare with ranking by the CNHP (Fayette, 1999).

Of great significance is the fact that the Severy Creek Watershed also includes a pure strain of the federally and state listed greenback cutthroat trout (Oncorhynchus clarki stomias). Only a handful of native pure greenback populations are known to exist in the Arkansas River Basin in which the Severy Creek Watershed resides. The main threat to the health and well being of the wetland, and consequently the population of greenback cutthroat trout, has been determined to be the flow of sediment from the Pikes Peak Highway through gullies created by stormwater discharge into the Severy Creek Watershed (Cooper, 1998). In 1998, the Sierra Club invited Dr. David J. Cooper, an alpine wetland restoration expert from Colorado State University, to examine the Severy Creek Wetland. His report concluded that 11,770 cubic yards of sediment has eroded into

the wetland burying 1/3 to 1/2 of the wetland's total area (Cooper, 1998). The deterioration of the wetland is clearly visible from the Pikes Peak Highway between miles 13 and 14. Dr. Cooper's report outlines a detailed plan for re-establishing the health of the wetland, with implementation of the plan estimated at $6 million dollars in 1998. The project outlined in this proposal tries to reach many of the same objectives of Dr. Cooper's proposal but at a smaller, less intensive scale. Restoration work proposed in the Severy Creek area will focus on stopping the advance of alluvium into the wetland and begin the process of restoring the wetland at the outer limits of the alluvial fan (Figure 2). Restoration work will serve to protect greenback cutthroat trout habitat by improving the water quality of Severy Creek through the reduction of sediment transport within the creek as well as to help mitigate further encroachment of sediment within the wetland, improving the wetland's health.

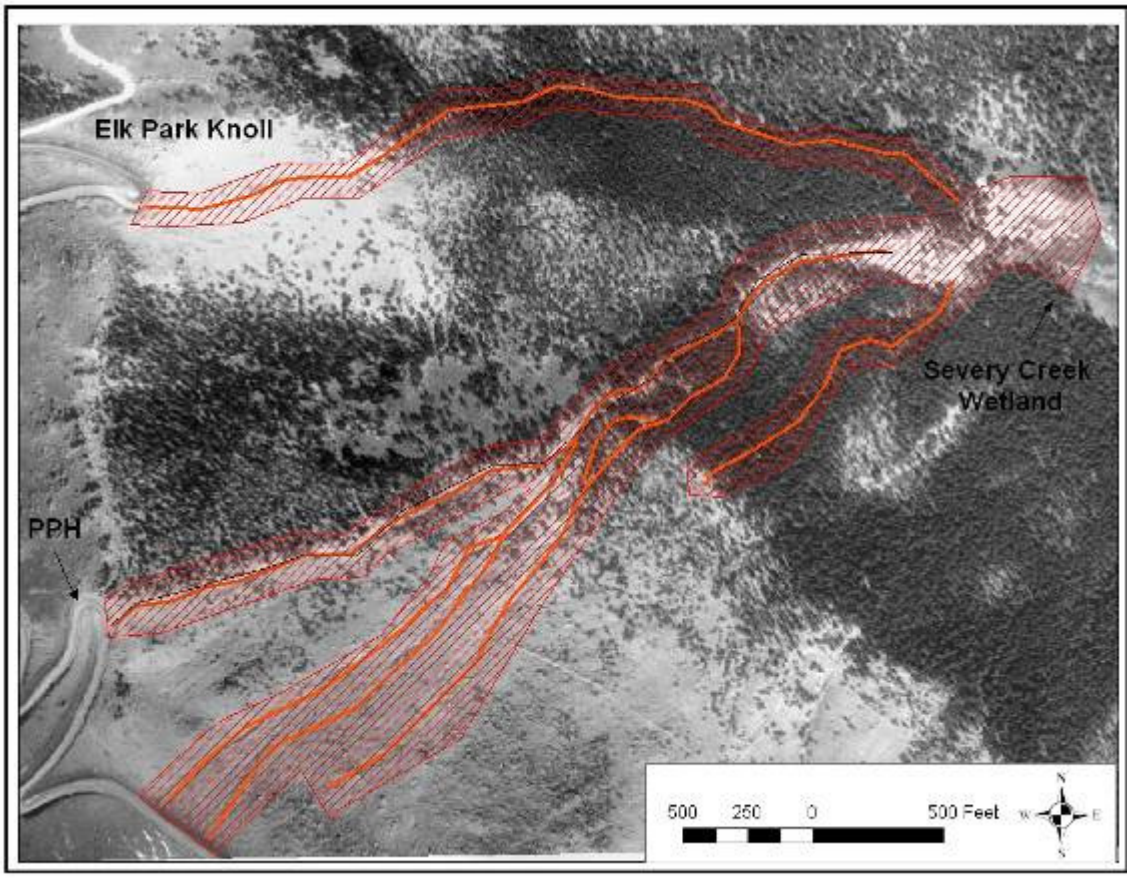

Figure 2. Overview of Severy Creek Wetland project area.

1.3 Ski Creek

Ski Creek is the informal name given to a tributary stream of South Catamount Creek. The creek initially starts out as a drainage channel that begins just above the Glen Cove Inn where stormwater runoff from the Pikes Peak Highway is discharged into the channel. This upper portion of Ski Creek is ephemeral in nature and only experiences above ground flow during spring snowmelt and summer thunderstorms when stormwater runoff from the Pikes Peak Highway is discharged into the channel. At approximately highway mile 10.5, the "creek" emerges as a large spring near the highway and maintains perennial flow. At this point, Ski Creek is a perennial tributary to South Catamount Creek, with which it joins two miles downstream just above South Catamount Reservoir.

Several studies have been completed on the health of Ski Creek and its adjoining wetlands. A 1993 Forest Service study concluded that the creek was out of equilibrium and was experiencing excessive amounts of sediment load (Chavez et al. 1993). Observed suspended sediment in the creek significantly exceeded the sediment threshold 100% of the time with the average exceedance calculated at 27,000% (Chavez et al. 1993). The several wetlands that exist along the length of Ski Creek are considered to be of high quality (Professional Wetlands Consulting, 1997). Unfortunately, these wetlands have been so severely affected by sediment deposition from the Pikes Peak Highway that they have been filled to the point of saturation (Snyder et al, 1994). The Ski Creek aquatic environment is also being negatively impacted by the high sediment loads the creek carries. According to a 2004 water quality report by Chadwick Ecological Consultants, benthic macroinvertebrate life within Ski Creek is considered stressed (CEC, 2005). Sediment loads carried by Ski Creek have also been found to be much higher than adjacent streams and are negatively impacting storage capacity of the South Catamount Reservoir; a primary source of drinking water for Colorado Springs (Chavez et al, 1993; Billmeyer, 2005).

While paving operations and sediment controls have been completed on the Pikes Peak Highway in the headwater area of Ski Creek, stormwater runoff from 1/2 mile of highway and drainage from 23 acres is still being conveyed into the upper ski creek channel. Using precipitation data supplied by Drexel Barrell and Company (1997), flows of 37 cfs are estimated to be discharged into the channel during a 25 year storm event

(3.25”/hr). A discharge of only 20 cfs within Ski Creek was estimated to carry a sediment bedload of 2094 ton/acre which would severely impact aquatic habitat (Chavez et al., 1993).

This phase of the project seeks to mitigate extreme erosion and sedimentation issues that are severely effecting a portion of the Ski Creek channel between Glen Cove Inn and an old ski snow-making “pond” just past mile 11 on the Pikes Peak Highway (Figure 3). This area is experiencing extreme erosion as evidenced by the presence of severe undercutting of the stream banks, several large knickpoints showing headward migration, and aggradation of the main channel causing multiple side channels to develop which are further destabilizing the drainage area and creating multiple tree kill sites. The proposed action would divert the stream from its existing channel into a previously used diversion trench. The old diversion channel would be reconstructed into a stabile and viable stream channel 1600’ in length after which it would rejoin the original stream channel. Ski Creek followed the course of the diversion channel until 1985 when the U.S.D.A Forest Service through the *Pikes Peak Ski Area Site Restoration Plan* redirected the water back into the original stream channel. At that time this reach of Ski Creek was determined to be “basically stable and able to handle the common flows” (USDA, 1987). However it appears that in 1991 several high intensity storm events in the upper Ski Creek basin caused massive sedimentation of the Ski Creek channel within this reach “limiting the capacity of the channel to handle high flows”(Nakada,1991). This influx of sedimentation would appear to be the forcing factor that destabilized this section of Ski Creek and has caused the extreme erosion and sedimentation apparent today.

Reconstruction of a stream channel in the area of the old diversion will allow the effected channel reach to stabilize. The newly constructed channel will be designed to handle 100 year storm events and will incorporate erosion control structures to limit flow velocities and sediment transport. Stream channel restoration work on a 1500’ section in the upper most reaches of Ski Creek will be completed by August, 2007 to address sediment transport and velocity of flow within this portion of the creek (Figure 3). By stabilizing this upper reach of Ski Creek it is also more likely that restoration efforts proposed for the Ski Creek drainage outlined in this report will be successful.

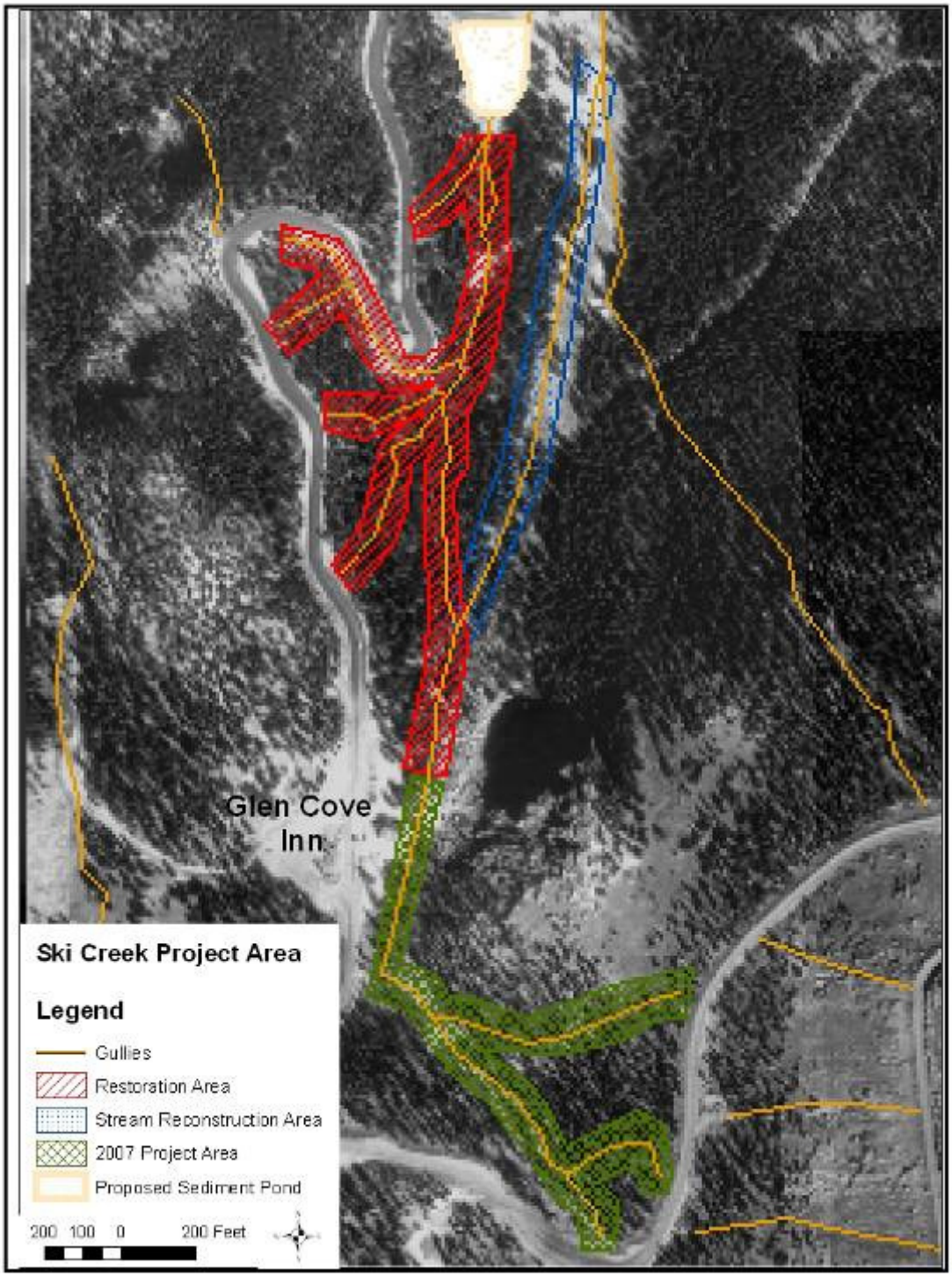

Figure 3. Overview of Ski Creek project area.

CHAPTER 2

SEVERY CREEK WETLAND PROJECT AREA

The Severy Creek Wetland is approximately 60 acres in size with an estimated 1/3 to 1/2 of the wetland buried in alluvium up to 6' in depth (Snyder *et al*, 1994; Cooper, 1998). This influx of alluvium has lowered the ground water table relative to the surface making natural re-establishment of the wetland's native vegetation impossible. In addition, forest stands of subalpine fir (Abies bifolia) and Engelmann spruce (Picea engelmannii) in the upper reaches of the wetland have been severely impacted by the sediment deposition. Tree mortality rates observed in these areas is very high due to the sediment deposition (Cooper, 1998).

Two extremely large gullies which receive flow directly from the Pikes Peak Highway are responsible for the majority of the in-fill material (Figure 4). The first gully emanates from the first hair-pin curve just past the turn off to Elk Park Knoll at mile 12.25. This gully (SG1) is approximately .65 miles long and over its length incises to a depth of 20' and a width of 25' (RMFI, 2003). The second gully (SG2) emanates from the second hair pin curve facing the wetland at mile 12.70. This gully is approximately .70 miles long and has incised to a depth of 25' and a width of 30' at it's most extreme (RMFI, 2003). This gully also receives additional stormwater flow from the Pikes Peak Highway through a series of gullies that have developed just up road from the primary gully. These gullies eventually intersect and combine just above SG2's discharge into the wetland. These gullies are major channels in and of themselves, measuring between 1600' and 2000' long with depths and widths similar to SG2. A third gully (SG3) has been identified that appears to be draining a large area just to the southeast of the second gully. This area is sparsely vegetated and is bisected by numerous rill formations. Field checks have not been able to ascertain if this area is being influenced by overland flow off the highway or if it is a natural collection point for water draining the hillslope. This gully is approximately 1300' long and at its extreme is 5' deep and 10' wide.

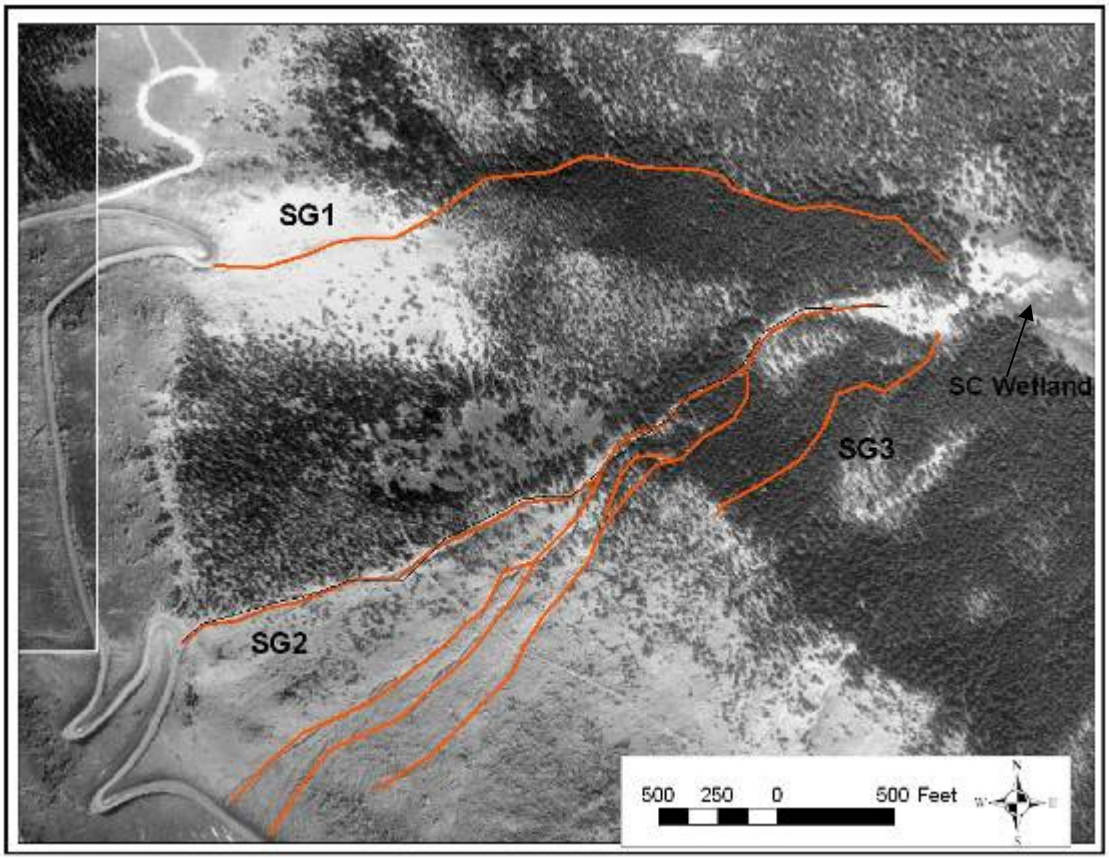

Figure 4. Overview of gullies draining into the Severy Creek Wetland

Highway mitigation practices to reduce runoff and dissipate energy into the Severy Creek Watershed were begun in 2005 and completed in 2006. A riprap weir (B60) installed in 2005 at the head of SG1 however is already showing signs that stormwater is piping through the structure. Additional reinforcement of this and other riprap weirs constructed along the highway appears necessary for these structures to perform as intended. Overall, the measures implemented should help in decreasing some of the large stormwater pulses that have been recorded as passing through the gully system from the highway (Cooper, 1998). However, natural peak discharge is still estimated at a significant flow of 124 cfs from the area of the gullies into the wetland for a 25 years magnitude event. In addition, the overall size and depth of the gullies will retain substantial quantities of winter snow and may be subject to releasing large flows during spring melt-off. Field surveys in 2005 found that the gullies have incised so deeply that

they have lowered the groundwater table creating new springs which are providing continual flow through the gully channels during the summer and fall.

The scale of the degradation that has occurred with the Severy Creek Watershed is well beyond the limited funds available for restoration work that has been allocated for that purpose through the settlement agreements with the City of Colorado Springs and the Forest Service. However, RMFI proposes to initiate and complete a project that will halt the advance of alluvium into the wetland and begin restoration efforts on the edges of the wetland that have been impacted by the sediment deposition using native materials available on site. The project will be completed in three phases with the following objectives as noted:

Phase 1) Stabilize the gully bottoms of gullies SG1, SG2, SG3, and all tributary gullies feeding into SG2. Stabilization of the gully bottoms will allow for establishment of vegetation and will make possible the stabilization of banks since the toe of the gully side slopes will be at rest.

Phase 2) Reduce and eventually eliminate downward migration of alluvium from the developed alluvial fan into the Severy Creek Wetland.

Phase 3) Restore an estimated 4 acres of wetland found in the upper part of the Severy Creek Wetland where deposition of alluvium is 1' or less. (The amount of acreage to receive restorative treatments may increase or decrease upon further examination of the depth of sediment deposits across the alluvial fan).

Successful completion of the project goals should result in no more loss of wetland acreage, begin to reclaim areas of wetland along the periphery of the alluvial fan, and improve the water quality and health of the Severy Creek Wetland. It is estimated that seven to nine years may be required to successfully complete all of the project goals

2.1 Proposed Action – Phase 1: Stabilization of Gully Channels

Without the stabilization of the gully bottoms and banks, alluvium will continue to move down through the gully channels and render any erosion control and restoration prescriptions used on the alluvial fan and wetland useless. The proposed action would use the abundant quantity of native rock material available in the vicinity of SG1, SG2, and

SG3 to create a series of loose rock check dams placed throughout the length of each channel. Access to the channels is difficult due to the steepness of slope, high elevations, and exposed terrain of the project area (examples of the gully work sites follow in Figures 6-8). Because access is so difficult, it will preclude the use of mechanized equipment and require that all structures be built by hand. A team of 9 to 12 individuals using methods developed to construct rock check dams in the North Crystal Creek Basin on Pikes Peak would be applied to this project (RMFI, 2006). These methods proved to be an efficient means to construct rock check dams in a remote setting with little disturbance of the project area.

Rock check dams built in the project area would consist of a series of low structures less than 2 meters in height. Structures of this height and lower have been found to provide the most stability and are less likely to fail if properly installed (Heede, 1976). The length and extreme grade of the gully channels will necessitate a large number of check dam structures to be placed within the gullies. Using guidelines developed by Heede (1976) for the spacing of rock check dams that are 1.8 meters high with an average gully gradient of 18%, SG1 will require over 60 structures and SG2, including its tributary gullies, will require over 150 structures. SG3 is less incised, requiring a smaller dam of 0.6 meters high, and thus it is estimated 15 structures will need to be built. Based on figures to construct dams in the North Crystal Creek Basin, it is estimated that 190 work days would be required to construct all dams. Because of the large number of structures needed, flexibility should be given on the type of loose rock structures permitted to be used. Heede (1976) outlines several different designs including wire-bound, single fence, and double fence loose rock structures depending on the channel grade and availability of rock and rock sizes. A typical loose rock check dam plan is presented in figure 5. All specifications for check dams will follow guidelines and equations as set forth by Heede (1976).

Material removed during the excavation of keys for the rock check dams would be used to back fill the structures and then seeded. As Heede (1976. pg. 11) states:

"Vegetation rehabilitation is speeded if large and deep deposits of sediment accumulate in the gully above engineering works. Such alluvial deposits make excellent aquifers, increase channel storage capacity, decrease channel gradients, and

thus, decrease peak flows. All these [factors] create conditions much more favorable to plant growth than those existing before control."

2.1.1 Alternatives to Proposed Action – Phase 1: Stabilization of Gully Channels

A. No Action – Gullies would continue to erode and transport sediment into the Severy Creek Wetland. Eventually a natural state of equilibrium would be reached and the gullies would stabilize. A geomorphic study of gullies in an area with similar characteristics as those found on Pikes Peak estimates that 300 years would be required for equilibrium to be reached (Moody, 1998).

B. Mixture of Rock Check Dams and Tree Cross Veins – Along the periphery of the gully banks stand a number of trees that are slowly having their roots undercut from them. These trees will eventually fall into the gully and depending on how they fall may provide a natural barrier to flow and sediment. The alternative action B would identify trees along the gully banks that could be cut and placed specifically in the gully to create a cross vein structure that will aid in reducing flow and sediment in the gully. The number of tree cross veins would be supplemented with the proper number of loose rock check dams to provide erosion control.

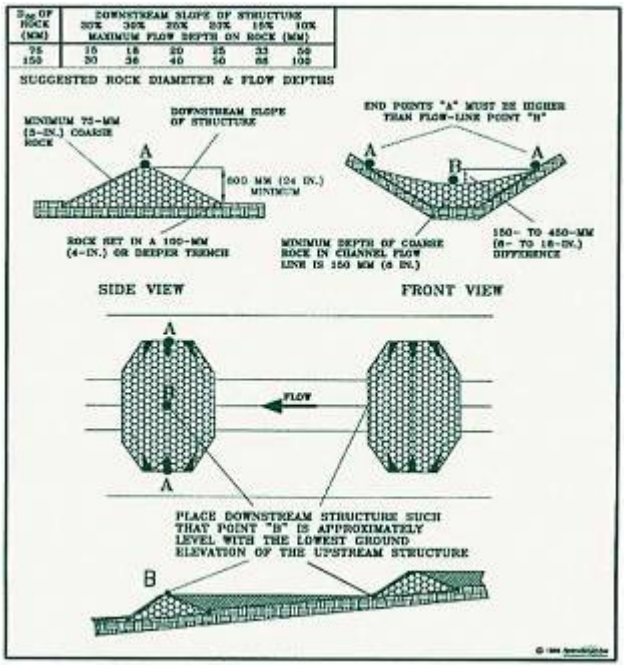

Figure 5. Typical design for a loose rock check dam (Fifield, 2000).

Figure 6. Examples work sites in SG1

Figure 7. Examples of work sites in SG2

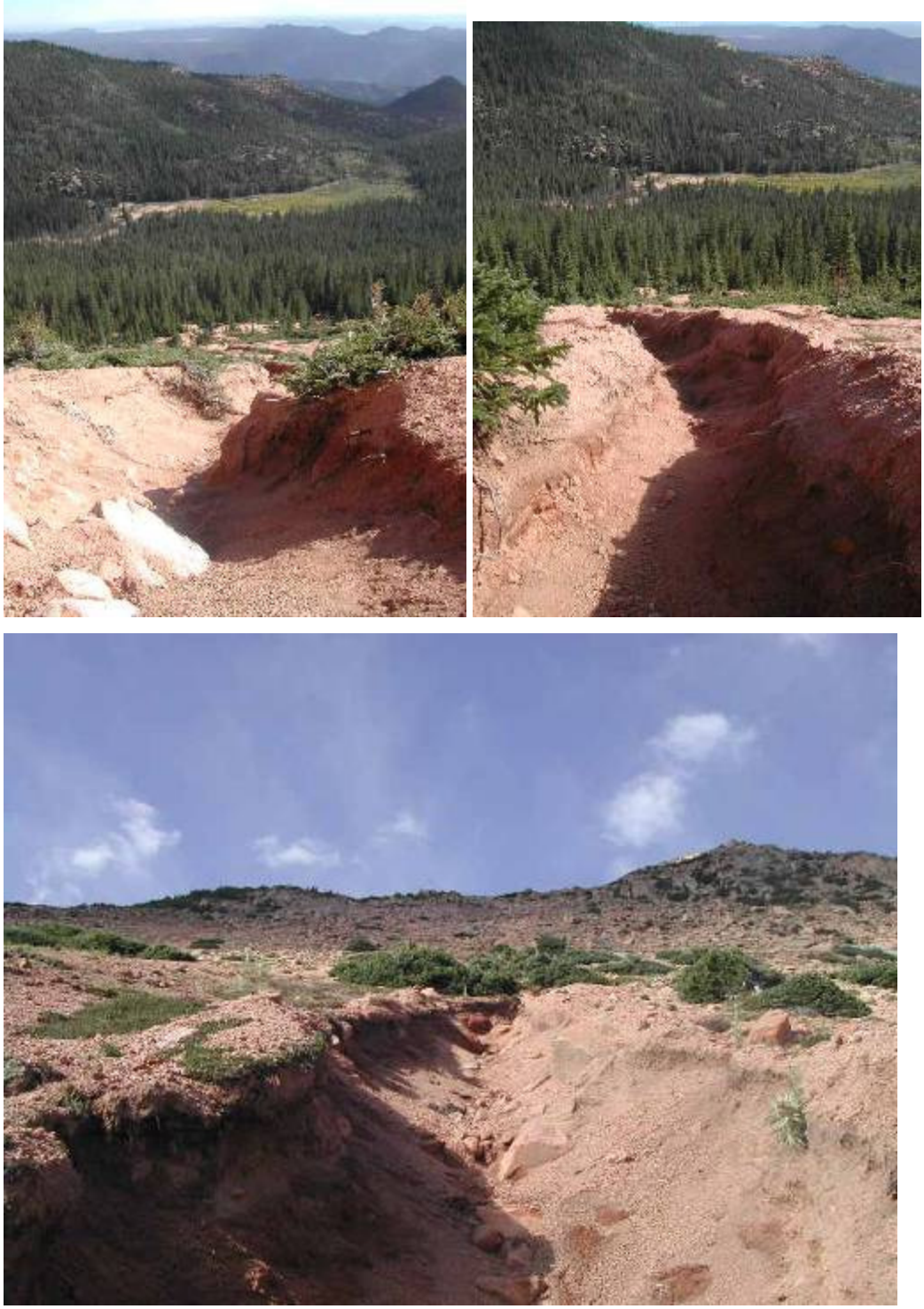

Figure 8. Example of work sites in SG3

2.2 Proposed Action – Phase 2: Stabilize Alluvial Fan

Once Phase 1 of the Severy Creek Project has been completed, work will progress to stabilize the large alluvial fan that has developed in the upper portion of the wetland. In order to slow downward migration of alluvium into the wetland, it is proposed that a series of directionally felled logs be placed at the head of the wetland area just past the distal end of the three gullies entering into the area. This area measures approximately 400' x 300' (Figure 9). Trees to be used for the erosion log barrier structures will be acquired from areas below SG2 were several dozen standing dead trees can be found (Figure 10). Additional trees will be required from adjacent areas not impacted by sediment deposition. These trees could be acquired through a forest thinning program. It is estimated that 160 logs will be required to cover the project area.

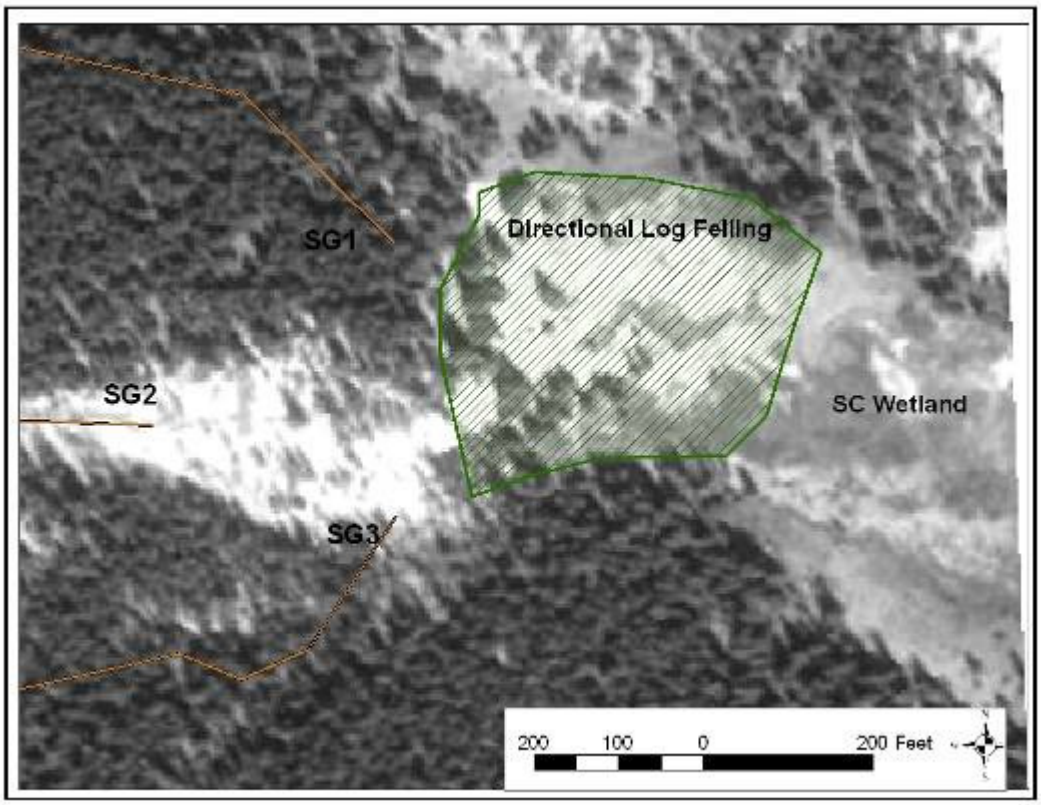

Figure 9. Close-up of erosion log barrier area (directional log felling).

Figure 10. Area below SG2 with standing dead fir and spruce.

The felled trees will be placed according to designs developed by the National Resource Conservation Service (Figure 11). As stated by the NRCS (2004), Erosion Log Barriers create a barrier that interrupts the movement of water down slope and thereby reducing sediment transport. This practice involves cutting the trees and dropping the trunks across the slope (perpendicular to the direction of water and sediment flow). In the project area, wood stakes 36 inches in length (24" buried and 12" above ground) will be used to brace the log. Tree limbs will be removed to the extent necessary for the log to lie flat on the ground, encouraging the collection of water and trapping debris moving down slope. As the trees decay they will provide much needed nutrients to be mixed into the surrounding soil. It is estimated the erosion log barriers would have a functioning life of 25 years, allowing enough time for vegetation on the alluvial fan to become well established. To aid vegetation growth, a high altitude grass seed mix* would be spread throughout the project area as well as planting seedlings of subalpine fir (Abies bifolia) and Engelmann spruce (Picea engelmannii). (*If the seed mix prepared by Smith

Environmental for subalpine areas adjacent to the Pikes Peak Highway proves successful, the same mix would be applied to this project)

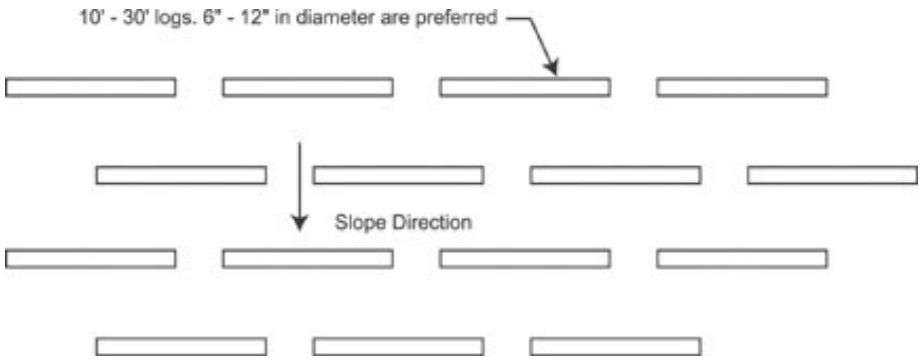

Figure 11. Erosion Log Barriers. (NRCS, 2004).

2.2.1 Alternatives to Proposed Action – Phase 2: Stabilization of Alluvial Fan

A. No Action – Alluvial fan would continue to transport sediment into the Severy Creek Wetland. Eventually a natural state of equilibrium would be reached and the alluvial fan would stabilize. The gullies transporting sediment and flow into the alluvial fan area however would need to stabilize first as the whole system is connected.

B. Seed and Plant New Trees – Alternative B would only involve spreading a high altitude grass seed mix throughout the project area as well as planting seedlings of subalpine fir (Abies bifolia) and Engelmann spruce (Picea engelmannii). Erosion log barriers would not be placed in the project area.

2.3 Proposed Action– Phase 3: Restoration of Wetland

After Phase 1 and 2 of the Severy Creek Project have been completed, it is proposed that 4.1 acres of the upper Severy Creek Wetland be restored to its prior functioning state (Figure 12). Reference sites will be established to identify hydric plant species that likely grew in the disturbed areas. Once identified, seed and stem cuttings will be collected from the appropriate plants at the reference sites. Collected seed and stem cuttings will then be grown in a greenhouse until planting can begin in the first spring after the site has been prepared. Preparation for planting will include installation of ground water monitoring wells to establish water table depths along the impacted periphery of the wetland. Pits and trenches will also be dug to identify the depth and elevation of buried soils (Cooper, 1998). This data along with the water level data will allow for the creation of a final grading plan for the entire project area.

To remove sediment from the impacted area, it is proposed that a high altitude helicopter be used to bring in a small disassembled excavator such as a Bobcat or Komatsu. The excavator would then be reassembled on site. This method would provide for minimal disturbance of the area. As sediment is removed from the wetland a suitable collection point in the basin needs to be identified. Access for crews to work on reseeding efforts will also need to be identified. Because of the extreme nature of getting to the wetland, crews should be allowed to camp for an extended period of time.

The ecological importance of the wetland will require that specific best management practices (BMP's) be developed that will avoid or minimize adverse environmental impacts that may result from wetland project construction activities. Most important will be the development of BMP's to ensure that whirling disease or a similar pathogen is not introduced into the waters of Severy Creek.

Figure 12. Approximate boundary of the wetland restoration area.

2.3.1 Alternatives to Proposed Action– Phase 3: Restoration of Wetland

A. No Action –No restoration of the Severy Creek Wetland would be implemented. Areas impacted by sediment burial will likely never return to wetland habitat and it is possible that more wetland habitat may be lost before the gullies and alluvial fan feeding into the wetland have stabilized.

B. Restoration of Wetland: No mechanized support – Alternative B would achieve the same results as the proposed action, however a small excavator would not be brought to the project site and all work would be completed with field crews. Assuming 1 acre of wetland can be restored each year, restoration of the 4.1 acres with field crews will take at least 4 years. This rate of restoration may be somewhat optimistic depending on the depth of alluvium that needs to be removed and where within the basin the alluvium can be re-deposited.

CHAPTER 3

SKI CREEK PROJECT AREA

The Ski Creek project area encompasses the portion of the Ski Creek channel between Glen Cove Inn and an old ski snow-making "pond" just past mile 11 on the Pikes Peak Highway (Figure 13). The project area covers 12.5 acres and includes a stream reach of approximately .63 miles as well as an additional half mile of stream reach from four tributary gullies. The project area is divided into three zones; a restoration zone, a stream reconstruction zone, and a snowmaking pond restoration zone.

The area identified for restoration has been severely eroded as evidenced by the presence of extreme undercutting of the stream banks, several large knickpoints experiencing headward migration, and aggradation of the main channel causing multiple side channels to develop which are further destabilizing the drainage area and creating multiple tree kill sites. Water flow through this section of Ski Creek was interrupted at some point during the time the Pikes Peak Ski Area was operational (1960's to the 1980's) and diverted into a trench indicated on the map for stream reconstruction (Figure 13). The trench was dug apparently to reduce the amount of sediment entering into the upper and lower snowmaking ponds. Unfortunately the original trench was dug into softened fill material where operators of the ski area had buried snowmaking pipes that were placed to transport water from the Glen Cove Creek Basin (USDA, 1987). The trench had eroded to depths exceeding 12 ft before being "discovered" by Forest Service personnel in 1985 (USDA, 1987). A temporary rediversion of the creek back into the original channel was constructed in 1985 and made permanent in 1990 through the *Pikes Peak Ski Area Watershed Improvement Project.* As stated earlier, the original creek bed at the time was considered "basically stable and able to handle the common flows." High intensity storm events in the upper Ski Creek basin that occurred in 1991 apparently caused massive sedimentation of the Ski Creek channel within this reach "limiting the capacity of the channel to handle high flows"(Nakada,1991).

It is interesting to note that several studies have shown that the stream flow in the upper section of Ski Creek is actually due to the alteration of Glen Cove Creek when the highway was constructed either for the original route established in 1888 or the improved current route established in 1915 (USDA, 1987; Burke, 2002, Billmeyer, 2004). A Forest

Service team investigating the erosion of Ski Creek briefly examined the feasibility of redirecting the stream flow back into Glen Cove Creek. The team concluded that rediverting the flow would cause "unacceptable siltation and alteration" of Glen Cove Creek (USDA, 1987). With implementation of the *Pikes Peak Erosion and Sediment Control Project* (Knight Piesold, 2002), much of the natural and stormwater flow that had been entering into the upper Ski Creek channel has now been diverted back into the Glen Cove Creek Basin at the Cove Pit Quarry site. Stormwater flow from the highway will continue to be conveyed into the Ski Creek drainage just below the Glen Cove Inn until this section of the highway has paving and erosion control measures installed no sooner than 2012.

It is apparent that the Ski Creek drainage has been artificially created and altered several times over the course of its history. The diversion of Glen Cove Creek, the failed diversion of Ski Creek for use at the Pikes Peak Ski Area, and the massive influx of sedimentation from prior highway maintenance activities has all played a role in the extreme degradation of the upper Ski Creek Basin we see today. The following proposed action will allow for the restoration of the effected forest habit adjacent to the original Ski Creek channel and provide a viable and stable stream channel for Ski Creek to flow through.

The proposed action will:

1) Divert Ski Creek from its current degraded and highly unstable channel into the area of the old diversion trench that will be reconstructed into a stable stream channel with meanders.

2) Apply restoration techniques to the tributary gully reaches and the degraded stream channel once the flow has been diverted to aid in stabilizing the channels and improving the forest health in the area.

3) Restore the old snow-making pond located 250' upstream from the sediment detention pond into a wet meadow or small pond.

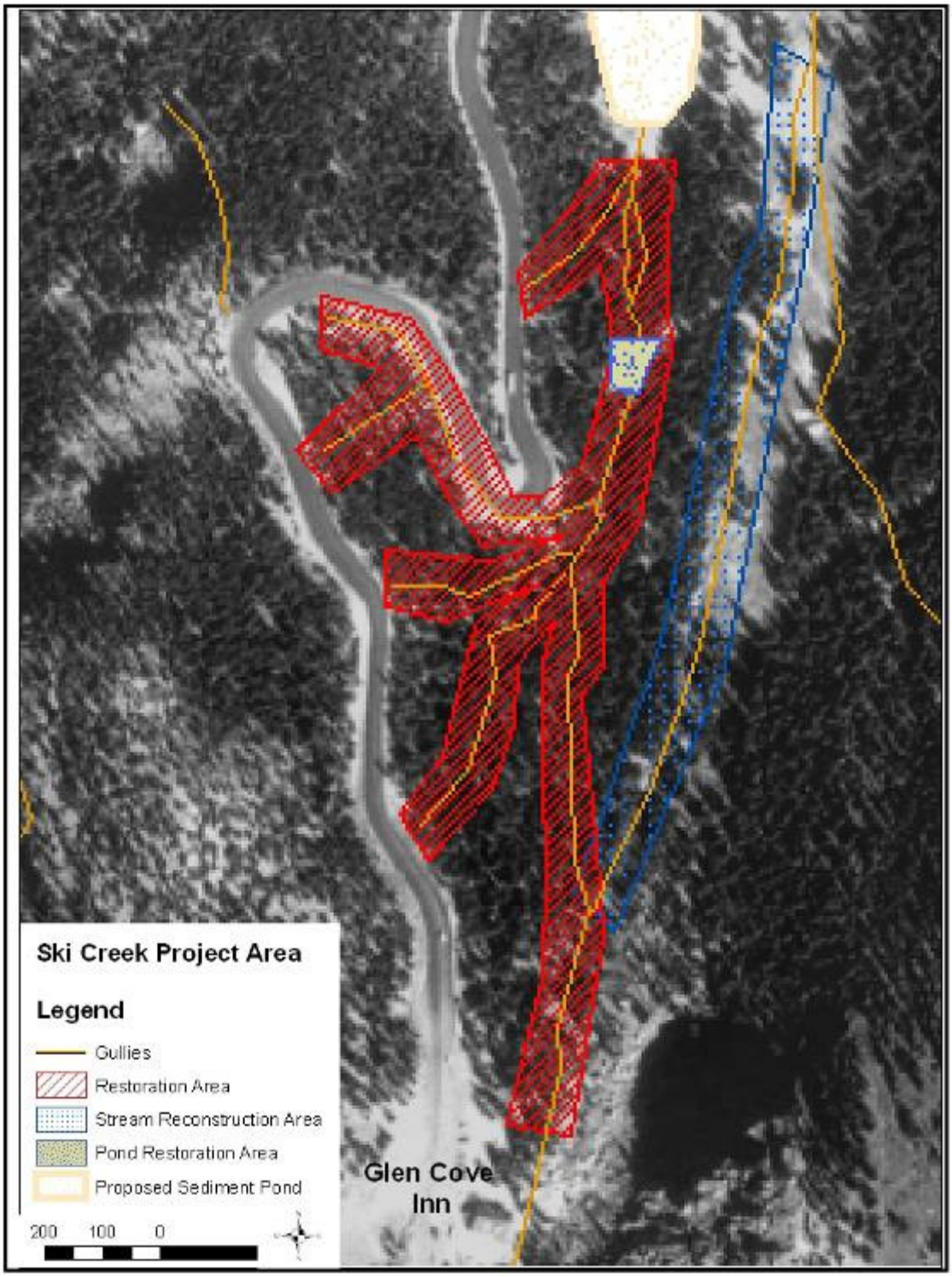

Figure 13. Overview of Ski Creek project area.

3.1 Proposed Action –Phase 1: Stream Reconstruction

Under the proposed action, the old diversion channel would be reconstructed into a stabile and viable stream channel 1600' in length after which it would rejoin the original stream channel just below the proposed sediment detention pond for the Pikes Peak Highway (Figure 14). Reconstruction of the stream channel this area would be done in conjunction with Fin-Up Habitat Consultants, a very experienced firm in implementing stream creation and habitat enhancement projects throughout the Rockies. Preliminary field visits show that access for machinery such as a Komatsu already exists along the previously disturbed area of the old ski area. The Komatsu would be used to excavate a new channel for Ski Creek creating an A2 or B2 stream type. The excavated channel would have cross vein and drop structures placed to reduce flow velocity and entrain sediment. The channel would be design to handle 100 yr storm events. Design plans will be finalized by summer 2007.

Figure 14. Overview of stream reconstruction area.

3.1.1 Alternatives to Proposed Action- Phase 1: Stream Reconstruction

A. No Action- Ski Creek would not be diverted into a reconstructed channel. Continued degradation of the original channel would continue until a natural state of equilibrium has been reached.

B. Stream Reconstruction- No alternative B has been developed at this time.

3.2 Proposed Action – Phase 2: Restoration of Original Channel

Removal of Ski Creek through this area is essential in order to truly stabilize the degraded channels and begin to improve the forest habitat adjacent to the channel. This section is approximately .38 miles long with an additional .33 miles of tributary gullies feeding into the main channel (Figure 15). This reach of the Ski Creek channel is experiencing severe erosion as evidenced by the presence of extreme undercutting of the stream banks, several large knickpoints experiencing headward migration, and aggradation of the main channel causing multiple side channels to develop which are further destabilizing the drainage area and creating multiple tree kill sites (Figure 16).

Once Ski Creek has been diverted, restoration of the area will begin. Restoration goals in this section will focus on stabilizing the stream channel and the large knickpoints that have developed by placing loose rock check dams throughout the reach. With an average gradient of 10% over the reaches length, an estimated 25 loose rock structures 1.0 meter in height will need to be constructed using guidelines set forth by Heede (1976). To address the knickpoints, larger rock check structures will need to be constructed just downstream of the knickpoint and grading of the bed channel accomplished. In addition to the rock check dams, some channel modification will have to be accomplished in areas where alluvium has completely filled in the channel and is causing the flow to spread laterally only to concentrate further downslope into multiple channels. These multiple channels are undercutting the root systems of fir trees in the area, severely affecting their ability to survive. By confining the flow into a single main channel and restoring the adjacent channels, erosion in these areas will be significantly reduced.

The majority of erosion control and restoration work in this section will have to be done by hand due to dense forest stands and steep terrain. Because this reach of Ski Creek flows through a glacial till deposit, extensive rock material of varying sizes is quite abundant and should provide enough native rock material for construction of all needed check dams.

One possible issue is that stormwater discharge from the Pikes Peak Highway will continue to be conveyed through the tributary channels until highway mitigation work is completed. Work is currently estimated to be concluded by the year 2012. Continued discharge of stormwater into these channels will make erosion control and restoration efforts more difficult, however, specific prescriptions can be applied before highway mitigation work is completed that will improve the overall health of the channel corridor.

3.2.1 Alternatives to Proposed Action- Phase 2: Restoration of Original Channel

A. No Action- This section of Ski Creek would not have restoration prescriptions applied. Continued degradation of the original channel and excessive sediment transport would continue until a natural state of equilibrium has been reached.

B. Restoration of Original Channel- No Diversion of Ski Creek - Ski Creek would not be diverted into a reconstructed stream channel and would continue to flow through the original channel. Additional or larger check dams may be needed to adjust for the increased flow and sediment load. Erosion control and restoration work would be limited to times of no flow in the creek bed and may extend the amount of time to complete project objectives.

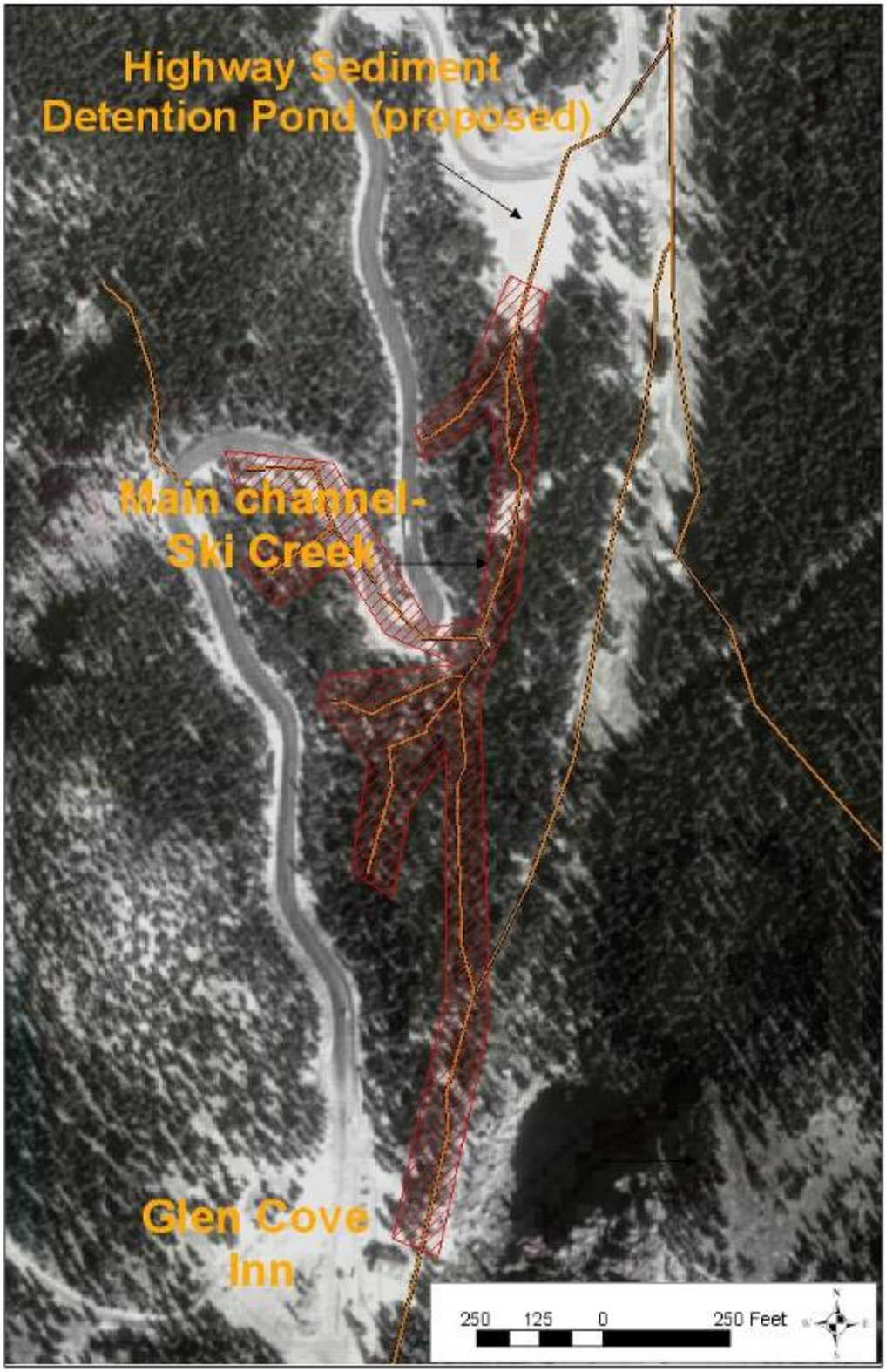

Figure 15. Overview of restoration area.

Figure 16. Examples of erosion problems occurring in the Ski Creek channel. (Upper left photo-large knickpoint below old snow-making pond. Upper right photo- undercutting of stream bank. Lower center photo-multiple channel erosion)

3.3 Proposed Action – Phase 3: Restoration of Snowmaking Pond

While the *Pikes Peak Erosion and Sediment Control Plan* proposes to build a sediment/runoff detention pond using the lower infilled snowmaking pond, it neglects to address the snow-making pond 645' upstream (Figure 17). This "pond" has been entirely in-filled with alluvium and is essentially spilling over with sediment (Figure 18). This phase of the project will excavate the "pond" as per the recommendation put forth by Snyder *et al* (1994) and attempt to restore the area into a small functioning pond or wet meadow.

To excavate the "pond", a small bobcat will be used to remove sediment. Apparently, sediment has been removed from this "pond" at least once before as two large piles of alluvium are located just to the east. A more suitable place for deposition of the excavated material will need to be established. It is possible that a small dump truck could be driven to the "pond" site, as an old access road to the area still exists, and the sediment deposited elsewhere (see Figure 17).

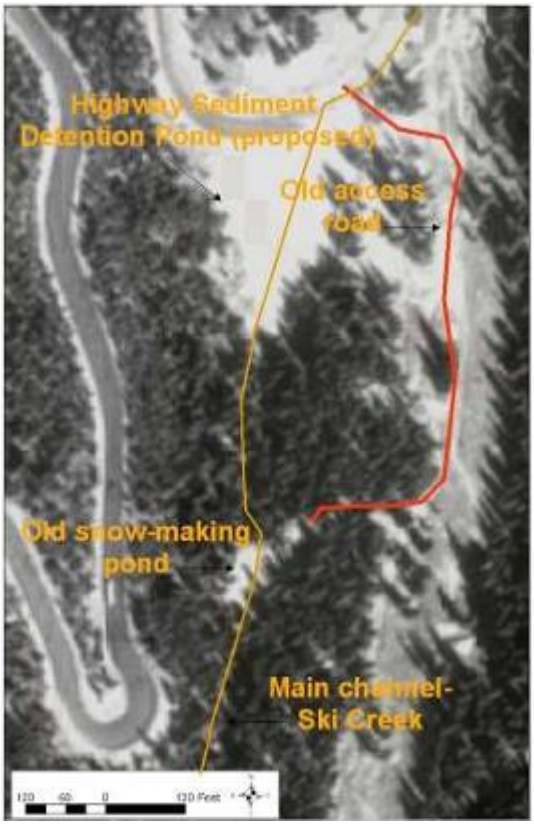

Figure 17. Location of old snow-making pond and access road

Figure 18. Old snow-making pond to be excavated (looking upstream)

3.3.1 Alternatives to Proposed Action- Phase 3: Restoration of Snowmaking Pond

A. No Action- The snowmaking pond would not be excavated or restored to a pond or wet meadow. Continued sedimentation of the "pond" would continue until a natural state of equilibrium has been reached in the Ski Creek channel feeding into the area.

B. Restoration of Snowmaking Pond – Excavation Only - The snowmaking pond would be excavated and the material would be transported off site possible to Cove Pit or another previously used gravel pit off the Pikes Peak Highway. The area would not be restored to a pond or wet meadow.

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