CHAPTER 2 ALTERNATIVES

BACKGROUND AND PLANNING ASSUMPTIONS

This chapter describes four alternatives (including no action), and the assumptions that guided their development. The alternatives were developed by Park Service, Forest Service, and Montana Department of Transportation staff based on resource concerns and values, past railroad operations, avalanche control methods, comments from the public and the report *Avalanche Risk Analysis John F. Stevens Canyon, Essex, Montana* (Hamre and Overcast 2004). There are 14 avalanche paths of concern within the project area that form the basis for the avalanche risk analysis (Map 2-1). The action alternatives range from no snowsheds and no explosive use permitted in the park for avalanche hazard reduction to permanent explosive use for avalanche hazard mitigation in the Park.

The actions described in the alternatives involve public lands in John F. Stevens Canyon, along the south end of GNP between US Highway 2 reference posts 185-191 (railroad mileposts 1159-1165). The railroad lies on a ROW granted by the USFS. Glacier National Park lies north of the ROW and FNF lands continue south of the ROW. US Highway 2 parallels the railroad through the project area on both the north and south side of Bear Creek. US Highway 2 lies on a ROW granted to MDT by the USFS.

Description of the Project Area

John F. Stevens Canyon runs from West Glacier to the Continental Divide at Marias Pass (Map 1-1). Both US Highway 2 and the BNSF railroad run along this travel corridor, which reaches an elevation of 5213 feet at the Pass. From West Glacier to the southern tip of the Park, the route follows the Middle Fork of the Flathead River, which is a Wild and Scenic River. At Java railroad switching station, the travel route turns east along Bear Creek. The railroad lies on the north side of Bear Creek and US Highway 2 lies on the south side of Bear Creek through the project area. The railroad is visible from the highway along most of this route.

The landscape in the project area consists of forested, steep mountains with lighter green avalanche paths in detectable relief. Most of the mountains are 7000 feet or higher in elevation. Small streams and waterfalls are full and visible during spring runoff and dwindle during the heat of the summer months. Bear Creek meanders through willows and meadows. The mountains are snow-covered during the winter months and natural avalanche activity is evident to the casual observer.

Private land parcels are located adjacent to federal land along US Highway 2. Two campgrounds and several trailheads for both National Park Service (NPS) and National Forest System (NFS) lands lie along the transportation corridor. South of GNP, the FNF lies west of the continental divide and the Lewis and Clark National Forest lies east of the continental divide. The Blackfeet Indian Reservation lies to the east of the NFS and NPS lands outside the project area. The Great Bear Wilderness lies to the west and south.

Privately owned buildings, railroad maintenance buildings, railroad snowsheds, Montana Department of Transportation (MDT) staging areas, trains, and vehicles are readily visible within the project area. With the exception of development along the transportation corridor, there is little visible evidence of human alteration of the landscape along the mountainsides. Trees, vegetation, and natural features camouflage trails, logging roads, and campgrounds. The railroad is audible throughout the canyon. Vehicle traffic noise also contributes to the sounds of human activity within the canyon.

Assumptions

The following assumptions are common to all alternatives in this document.

1. The cooperating agencies (NPS, USFS, and MDT) and their administered lands would continue to be managed according to laws, regulation, and policy specific to each agency (described in Chapter 5).
2. The BNSF railroad would remain in its current location on the USFS right-of-way.
3. BNSF would continue to be responsible for maintaining, improving infrastructure and administering the railroad in the ROW.
4. Existing snowsheds would remain in their present locations.
5. US Highway 2 management, operations, and repair would continue to be administered by the MDT.
6. US Highway 2 would remain in its current location on the right-of-way administered by the USFS.
7. MDT would continue to manage the US Highway 2 corridor during winter weather in accordance with their standard operation procedures.
8. The temporarily permitted United States Geological Survey (USGS) weather station on Snowslip Mountain and the Natural Resources Conservation Service SNOTEL station (snow pack telemetry) at Pike Creek would remain in place and continue to provide weather data to aid avalanche forecasters in avalanche hazard assessment.
9. The 14 avalanche paths that are discussed in the report *Avalanche Risk Analysis John F. Stevens Canyon, Essex, Montana* by David Hamre and Mike Overcast are the only avalanche paths that are considered for treatment in this EIS. These paths have been identified in this report as having high avalanche risk.

ALTERNATIVES

The initial paragraph of each alternative description provides a brief description of the main points. A bulleted list then provides an overview of the actions. A detailed description of the action items follows the bulleted list. Table 2-1 presents the general differences between the alternatives and tables 2-3 and 2-4 present a detailed comparison of the alternative action items and individual avalanche path treatments.

Actions Common to All Alternatives

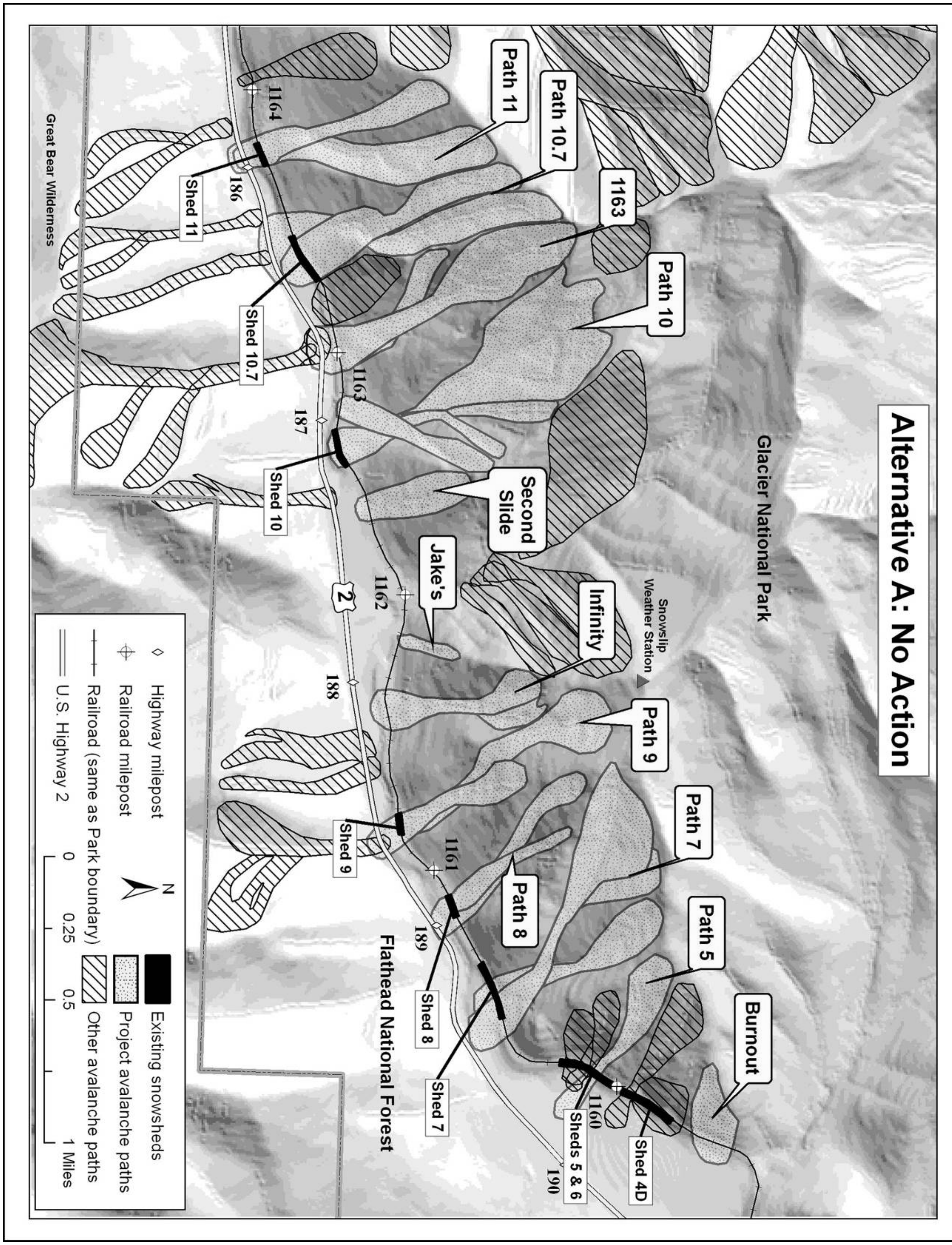
Several actions are common to all alternatives, including the No Action Alternative. Avalanche hazard forecasting, use of an Avalanche Safety Director (ASD), use and maintenance of avalanche detection wire, avalanche safety training, and avalanche safety operations are in use currently and are expected to continue to be used during and after implementation of the preferred alternative. These actions are discussed in detail under the No Action Alternative discussion.

Table 2-1. General comparison of alternatives.

Alternative A: No Action	Alternative B: BNSF Constructs Snowsheds (Preferred Alternative)	Alternative C: Permit Explosive Use for up to 10 years upon commitment from BNSF to Construct Snowsheds	Alternative D: Permanent Explosive Use Program (BNSF Proposal)
No explosive use permitted within GNP BNSF would maintain existing snowsheds BNSF may choose to construct new snowsheds or extensions Avalanche hazard would stabilize naturally after each storm event Forecasting, stability testing, and train delays would reduce avalanche risk	No explosive use permitted within GNP. Avalanche hazard would stabilize naturally after each storm event. Snowshed construction recommended to protect equipment, personnel and freight according to *Avalanche Hazard Analysis, John F. Stevens Canyon, Essex* (Hamre, and Overcast, 2004-Appendix A) Forecasting, stability testing, and train delays would reduce avalanche risk until snowsheds are constructed	A Special User Permit for Explosive use would be issued for up to a 10-year period-number of years depends on the level of commitment by BNSF. Permitted explosive methods would include: handcharges, Avalauncher, Avalhex type systems, blaster boxes and helicopter delivery An extensive resource monitoring program would insure that impacts are within determinations made in this EIS. If they exceed those determinations, changes in the explosive use program would occur	A permanent program of explosive use would be permitted for up to 3 avalanche cycles per year (more with permission) Permitted explosive methods would include: military artillery, handcharges, Avalauncher, Avalhex type systems, blaster boxes and helicopter BNSF would maintain existing snowsheds BNSF would extend Shed 7 (100 feet) and Shed 9 (150 feet)

ALTERNATIVE A: NO ACTION

The no action alternative provides the basis for comparing the effects of the other alternatives. Map 2-1 gives a detailed depiction of the no action alternative. The no action alternative describes the conditions that would continue to exist along the BNSF ROW between railroad mileposts 1159-1165 if no additional avalanche hazard mitigation was implemented. This alternative assumes that existing avalanche safety programs, detection systems, forecasting, and non-explosive snowpack stability testing would continue to be implemented to reduce the hazards to BNSF trains and personnel. This alternative also assumes that instability would naturally be reduced over a period of hours or days, allowing regular rail traffic to continue after high avalanche hazard conditions abate. BNSF currently maintains nine snowsheds in the project area. BNSF would be responsible for the cost of avalanche hazard assessment, avalanche forecasting, avalanche caused train delays and restrictions under this alternative.



Map 2-1. Alternative A: No Action

None of the avalanche hazard reduction actions that BNSF currently conducts affects NPS, NFS, or MDT lands. Non-explosive stability testing and weather data collection currently occur on NPS and NFS lands, but have negligible impacts to resources on those lands. The railroad ROW on NFS land is 200 feet wide; 100 feet each side of the railway centerline. The north boundary of the right-of-way is the southern boundary of Glacier National Park. The actions described below, with the exception of weather data collection and non-explosive stability testing occur on the BNSF right-of-way across NFS lands. The USFS has limited authority over actions that BNSF can take on the right-of-way based on an easement signed in 1891 resulting from the Railroad Rights of Way Act of 1875.

The following actions would continue to occur:

- Avalanche signal fences in six avalanche paths would be maintained.
- Nine existing snowsheds would be maintained.
- The BNSF Avalanche Safety Director (ASD) would use Snowslip weather station data and Pike Creek SNOTEL information to predict avalanche hazard in John F. Stevens Canyon. Snowslip weather station is permitted temporarily and would be removed when the US Geological Survey determines avalanche cycle research is complete.
- The BNSF Avalanche Safety Director would use non-explosive stability testing to determine snow stability on slopes with different aspects.
- The BNSF Avalanche Safety Director would provide avalanche safety training and avalanche rescue training to BNSF railroad crews.
- BNSF would delay train traffic in the John F. Stevens Canyon area when avalanche danger is high or when avalanche debris has crossed the tracks as determined by the Avalanche Safety Director. High avalanche danger is defined by snow instability, natural avalanche activity, and weather conditions.

Avalanche Detection System

BNSF would continue to maintain signal wire in six avalanche paths. The signal wire is used in two locations where snowsheds have been breached (Shed 7, Shed 10.7) and in four paths without snowsheds (Burn Out, Jakes, Second Slide, and 1163). (Breached refers to avalanche debris running past the ends of existing snowsheds). Signal wire is an avalanche detection device that lines the upper slope of railroad tracks across avalanche paths. When the wire is stretched or broken, the wayside signal system displays red to alert rail traffic of avalanche debris that has crossed the tracks. BNSF staff would continue to repair signal wire broken by avalanches in active avalanche zones.

Snowsheds

Under the no action alternative, BNSF would likely continue to maintain nine existing snowsheds (Shed 4D, Shed 5, Shed 6, Shed 7, Shed 8, Shed 9, Shed 10, Shed 10.7, and Shed 11). The snowsheds were built in the early 1900's to reduce avalanche risk in John F. Stevens Canyon. The snowshed walls and roofs were constructed of creosote treated timbers. BNSF would continue to maintain the existing wood structures. Avalanche path widths have become extended beyond the length of seven existing snowsheds. The sheds are only 100% effective when covering the whole length of an avalanche path. A shed that does not cover the whole path may allow avalanche activity to breach openings on either end of the shed. BNSF staff and equipment would continue to clear the tracks that are not protected by snowsheds. While BNSF could choose to build new snowsheds or add onto the existing ones, for the purposes of the No Action Alternative, it is assumed that no new snowsheds would be built and snowsheds would not be modified or lengthened.

Avalanche Forecasting

According to BNSF, their Avalanche Safety Director (ASD) would continue to provide specific, local avalanche hazard information for the railroad. Weather patterns would be observed and risk assessed when predictable avalanche conditions occur. Conditions observed would include type and amount of precipitation, temperature, wind, snow water equivalent of snow, relative humidity, barometric pressure, and weather trends. Snowpack analysis for weak layers would be used to determine failure planes within the snowpack. *Rutschblock* tests, compression tests, tilt board tests, shear frame tests, stuff block tests, ski cutting, and shovel shear tests are non-explosive stability testing techniques that can be employed by avalanche forecasters to determine unstable snow layers. The stability testing methods above would continue to be conducted on NPS or NFS land. Weather data, snowpack stability and avalanche information would continue to be recorded into BNSF logs.

The United States Geological Survey (USGS) temporary weather station on Snowslip Mountain and the US Department of Agriculture Natural Resources Conservation Service Pike Creek Snotel site would continue to provide constant local weather data to forecasters. This information would be used to determine the existence of typical avalanche cycle conditions. The Snowslip weather station would be removed when the USGS project is complete.

The ASD would be responsible for BNSF avalanche safety training of railroad crews and would be present during crew exposure to avalanche hazard. Railroad employees exposed to avalanche conditions would continue to undergo avalanche safety awareness and rescue training as part of their duties. Employees in these situations would continue to be equipped with shovels, probes, and avalanche transceivers. BNSF rescue personnel would be present and available to reduce the chance of employee fatality due to avalanche.

Avalanche Hazard Reduction

Under the No Action alternative, the NPS would not permit explosive avalanche triggering on NPS lands in John F. Stevens Canyon. The ASD would make an avalanche hazard determination based on non-explosive stability testing described above and weather data collection on whether railroad delays or restrictions would be employed until hazards stabilized naturally.

Highway and Railroad Delays

BNSF would continue to delay train access to the area when the tracks are blocked by an avalanche or when the ASD determines that the avalanche danger is too high for trains to cross the area safely. Trains would continue to be delayed until the avalanche risk is reduced naturally or until avalanche debris is removed. According to BNSF, Amtrak passengers would continue to be bussed south around John F. Stevens Canyon on U.S. Highway 200 and 83, or delayed until conditions change. MDT would continue to close US Highway 2 temporarily during periods of avalanche danger or hazardous driving conditions, according to their hazardous condition standard operating procedures (http://www.mdt.mt.gov/publications/docs/manuals/mmanual/chapt8c.pdf).

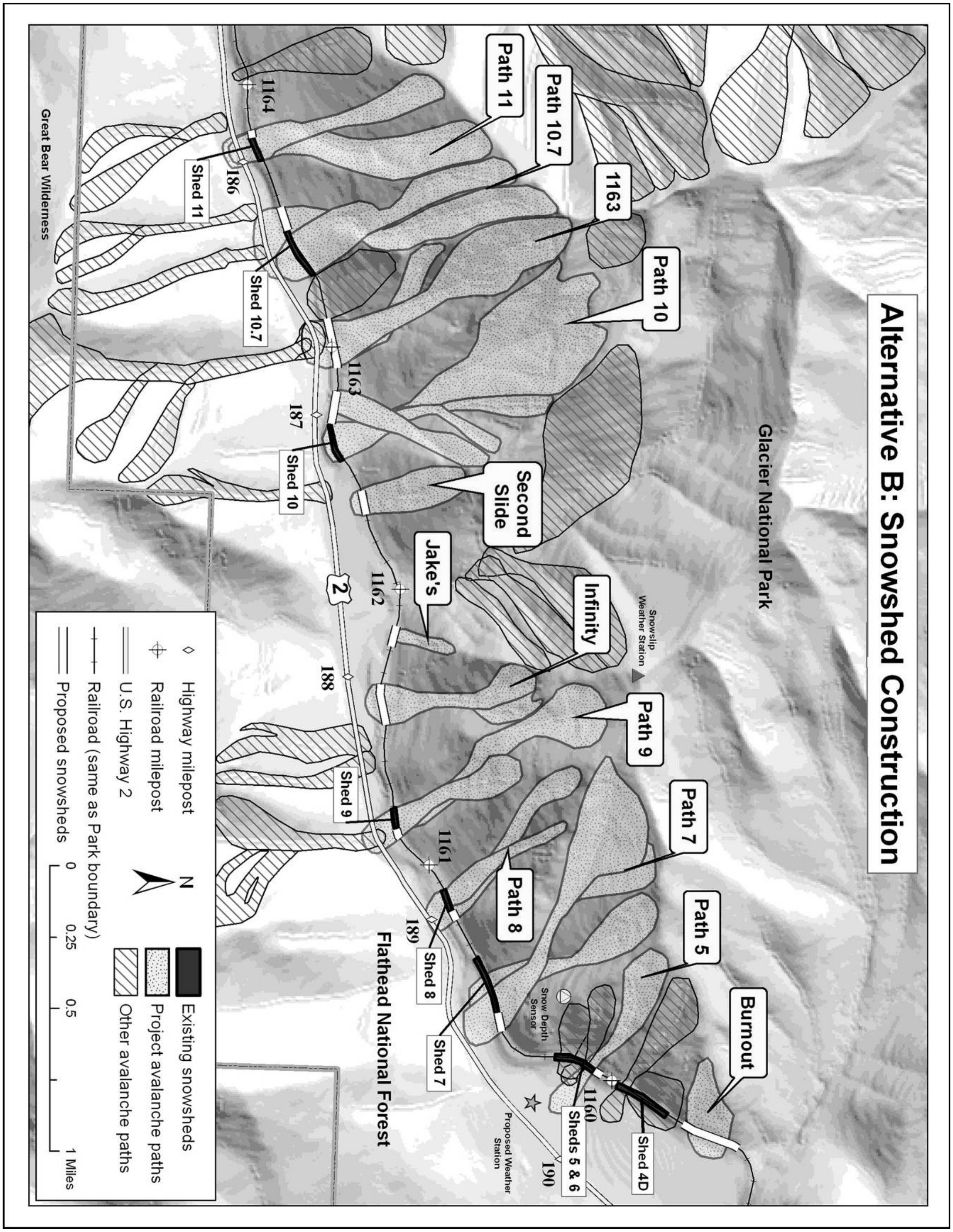
ALTERNATIVE B (PREFERRED)

NPS, USFS, and MDT recommend that BNSF construct or modify snowsheds. BNSF would continue to conduct avalanche monitoring, weather forecasting, detection system use, and non-explosive stability testing.

This alternative includes actions that neither the National Park Service (NPS), the US Forest Service (USFS) or the Montana Department of Transportation (MDT) have jurisdiction or authority to require BNSF to follow. This alternative is considered because it is a reasonable alternative in accordance with the National Environmental Policy Act. This alternative would require a special use permit for installation of a weather station and snow depth sensor on federal land. Map 2-2 depicts the action changes proposed under Alternative B.

Under this alternative BNSF would construct additional snowsheds and add on to the existing snowsheds in those paths defined by Hamre and Overcast (2004) as having high avalanche hazard. BNSF would perform avalanche monitoring, forecasting, and detection system installation. BNSF maintains nine snowsheds on the right-of-way administered by the USFS. The snowsheds are owned by BNSF and are on private land. BNSF could opt to build or lengthen snowsheds based on their assessment of avalanche risk. According to BNSF, the construction of snowsheds would take several years. BNSF could substantially reduce their risk during the construction process by delaying railroad traffic during periods of avalanche danger and by utilizing avalanche risk forecasting, weather forecasting, avalanche training for personnel, and travel restrictions for Amtrak (Hamre and Overcast 2004). The reduction in avalanche risk would be a function of delays or restrictions on train traffic during periods of high avalanche hazard. If safety delays or restrictions were followed, the avalanche hazard would be reduced substantially. Permanent structures under this alternative would include snowsheds, avalanche detection systems, a weather station, and a snow depth sensor. The new weather station would be located on National Forest System (NFS) land and the snow depth sensor would be located on National Park Service (NPS) land. BNSF would be responsible for the cost of avalanche hazard assessment, avalanche forecasting, avalanche caused train delays and restrictions until snowsheds are built. BNSF would bear the costs of snowshed construction along the ROW. The following avalanche hazard reduction methods could be used by BNSF under this alternative. Tables 2-1, 2-3, and 2-4 provide a comparative explanation of action items for each alternative. Unless noted, all work would occur on NFS lands in the existing BNSF ROW:

- BNSF would build snowsheds in avalanche paths that currently do not have snowsheds (total 3,540 feet). BNSF would lengthen existing snowsheds that do not provide sufficient protection from avalanche activity (total 1,500 feet) due to widening of the avalanche path. BNSF may prioritize the construction of new sheds and shed extensions depending on the risk level of each path as determined by Hamre and Overcast (2004).
- Until snowsheds were built, the reduction in avalanche risk would depend on avalanche hazard forecasting and imposed delays or restrictions on the railroad. If restrictions were imposed, there would be a measurable reduction in risk.
- Avalanche signal wire would continue to be used in avalanche paths without snowsheds or in snowshed bypass areas.



Map 2-2. Actions under Alternative B

- Avalanche detection systems such as the Avalanche Sentry, geophones, and/or Doppler radar could be installed in or adjacent to unprotected avalanche paths within the park.
- Avalanche forecasters would monitor avalanche conditions and make recommendations depending on hazards in specific avalanche paths until recommended snowsheds were completed.
- A new weather station at elevation 4600 feet would be installed at RP 189.8 off US Highway 2 on NFS land.
- The BNSF Avalanche Safety Director (ASD) would use Snowslip weather station data and Pike Creek Snotel information to predict avalanche hazard in John F. Stevens Canyon. Snowslip weather station is temporary and intended to be removed when the US Geological Survey determines avalanche cycle research is complete.
- A snow depth sensor would be installed on NPS land at elevation 5600 feet on the ridge between Shed 7 and Shed 6 avalanche paths. It would be removed when snowsheds are constructed.
- BNSF would delay train travel through the John F. Stevens Canyon area when avalanche danger is high or when avalanche debris crosses the tracks. High avalanche danger is defined by snow instability, natural avalanche activity, and weather conditions causing instability and natural avalanche activity.
- A BNSF explosive use request would only be permitted by the park, under extenuating circumstances, when all other options have been exercised and there is imminent threat to human life or resources.

Snowsheds

New snowsheds would be constructed by BNSF across five active avalanche paths between US Highway 2 reference posts 185-191 (these avalanche paths are currently monitored by signal wire). The new snowshed lengths would protect the extent of the track length affected by avalanche activity (Table 2-5). Seven of the existing nine snowsheds would be lengthened to include the entire extent of the track length affected by avalanche activity. Snowsheds would be built and extended as recommended in the *Avalanche Risk Analysis John F. Stevens Canyon, Essex, Montana* (Hamre and Overcast 2004). Snowshed construction or lengthening would reduce the avalanche risk significantly. (Hamre and Overcast 2004). BNSF would determine the number, final lengths, and locations for new snowsheds or extensions. The amount of snowshed construction would depend on the amount of residual risk the company is willing to reduce by other means such as closures, rerouting traffic, detection systems, forecasting and training.

For the purpose of this document, it is assumed that priority for building new snowsheds would be given to those sheds that have the highest avalanche risk (Hamre and Overcast 2004). The priority order from greatest to least avalanche risk would be Burn Out (900 feet), 1163 (1200 feet), Second Slide (440 feet), Jakes (600 feet), and Infinity (400 feet). With new snowshed construction, excavation may be required to build the structure into the hillside. While snowshed construction would occur mostly on the ROW, impacts adjacent to the ROW on NPS lands are expected. Up to 5,040 feet of new snowshed, including extensions could be constructed along the project area as recommended in the *Avalanche Risk Analysis John F. Stevens Canyon, Essex, Montana* (Hamre and Overcast 2004).

Snowshed extensions and new snowsheds would be constructed of prefabricated concrete walls and roof supported by a steel frame according to a BNSF Engineer. The concrete and steel would be colored to match the existing snowsheds. The new sheds and extensions would look very similar to the existing sheds. The construction of new snowsheds or extensions would be thoroughly documented to record impacts to the existing historic snowsheds. According to the BNSF engineer, the new snowsheds would require little maintenance and would be inspected annually. BNSF would be encouraged to include wildlife crossing structures, wildlife escape openings, and/or bat crevices into the snowshed design where appropriate and possible. The terrain in some proposed snowshed areas makes it impossible to incorporate wildlife crossings into the snowshed design.

Avalanche Detection System

BNSF would continue to use signal wire and/or another avalanche detection system in addition to snowsheds. BNSF would continue to maintain the existing signal wire detection system, although technology is rapidly advancing for avalanche detection. Current detection technology would not provide enough time for a train to stop before hitting the avalanche even if the equipment were placed in starting zones. Detection technology would be used in combination with forecasting to determine avalanche risk and hazard along the length of track in the project area by warning BNSF personnel when avalanche debris hits the tracks. The technology below would provide additional avalanche safety for the railroad.

BNSF could install and use more advanced Avalanche Sentry type detection systems, Doppler radar, and/or geophone detection technology. While these technologies may have drawbacks, future technology may make a system that would work for application in the project area. The Avalanche Sentry type systems detect infrasonic sound waves under the snowpack with a temporary array of 6-inch square metal boxes affixed to lengths of hose placed on the ground before snowfall. This system involves a solar or regular electric source and a computer data processing unit. All of the equipment would be on the ROW or in the runout zones on NFS lands. Doppler radar would require fixed equipment just outside of the runout zone on ROW land. The Doppler radar sensor, solar panel, and remote transmitter would be fixed on a 15-20 foot tower. Geophone vibration sensing technology would require fixed structures on BNSF ROW land for detection of avalanches that cross the tracks. The geophone instruments would be set in the ground in a two-foot square area along the edge of the avalanche path on the right-of-way. The geophones would be connected to the Doppler radar tower for power and radio transmission. All detection equipment would employ a remote system to activate alarms in BNSF vehicles and trains. Currently, geophones cannot be used in an environment that has vibration noise from a non-avalanche source such as trains. If the technology improves to allow use of this device with trains, the instruments may be installed. This equipment would only detect avalanches in those paths where it was installed. Remote cameras or continuous video may be installed along the ROW to differentiate false alarms from actual avalanche activity. Visual devices would only be effective during daylight hours.

Avalanche Forecasting

BNSF avalanche forecasters would continue to provide specific, local avalanche hazard information for the railroad. However, the amount of area monitored and tested would be significantly reduced once snowsheds were constructed. Weather patterns would be observed and risk assessed during predictable pre-avalanche conditions. Conditions observed would include type and amount of snow precipitation, temperature, wind, snow water equivalent, relative humidity, barometric pressure, and weather trends. Snowpack analysis for weak layers may be used to determine failure planes within the snowpack. *Rutschblock* tests, ski cutting, compression tests, tilt board tests, shear frame tests, stuff block tests, and shovel shear tests are non-explosive stability testing techniques that would be employed by avalanche forecasters to determine unstable snow layers. Weather data, snowpack stability and avalanche information would be continuously recorded into BNSF logs. BNSF would monitor avalanche paths through direct observation and record natural avalanche activity, and other weather events such as wind scour and deposition patterns.

The temporary USGS weather station on Snowslip Mountain and the Pike Creek Snotel site would continue to provide continuous local weather data to forecasters. This information would be used to determine current snow conditions and avalanche hazard levels. The Snowslip weather station would be removed after snowsheds are completed. A weather station at a lower elevation (4600 feet) would be installed at reference post 189.8 along US Highway 2 on NFS land. The weather station would be a tripod structure with 6-inch square feet. Weather station stability would be reinforced with rebar lengths driven into the ground. The weather station would be non-obtrusive and painted white to blend into the winter surroundings. A snow depth sensor would be placed on NPS land at elevation 5600 on the ridge between Shed 6 and Shed 7. The sensor would be a fixed pipe with a perpendicular arm located above the snowpack. The arm has a sonic sensor that measures the snow depth from above the snowpack. The snow depth sensor would have a radio transmitter to send information to forecasters. These weather data collection devices would be a temporary fixture in a recommended wilderness area within the Park and would be removed once snowsheds are completed.

The ASD would be responsible for BNSF avalanche safety training for railroad crews and would be present for crew exposure to avalanches. Railroad workers exposed to avalanche conditions would continue to receive avalanche awareness, safety, and rescue training as part of their duties and would be equipped with shovels, probes, and avalanche transceivers. Spotters and rescue personnel would be available to reduce the chance of worker injury or fatality due to avalanche.

Stability Testing and Avalanche Triggering

Non-explosive stability testing would be used and includes methods such as *Rutschblock* tests, ski cutting, compression tests, tilt board tests, shear frame tests, stuff block tests, and shovel shear tests. Avalanche forecasters could use any of these methods to determine stability in avalanche paths. The ASD would make an avalanche hazard determination based on non-explosive stability testing and weather data collection on whether railroad delays or restrictions would be employed until hazards stabilized naturally.

Under Alternative B, the NPS would not permit explosive avalanche triggering. GNP reserves the authority to grant an exception under extenuating circumstances when all other options have been exercised and there is imminent threat to human life and or resources. Hand charges, helicopter delivery, and Avalauncher would be the only permitted explosive methods during such an emergency. See Alternative C below for a description of these methods. GNP would not issue a special use permit for explosive use to reduce railroad delays or to conduct preventative avalanche hazard reduction.

Highway and Railroad Delays

Railroad delays would be unnecessary once snowsheds are constructed and existing snowsheds are lengthened. During construction, the railroad would delay traffic when the tracks are blocked by avalanche debris or when the ASD determines that avalanche danger is too high for trains to travel through the canyon safely. Trains would be delayed until the avalanche risk is naturally reduced or avalanche debris is removed. According to BNSF, if railroad traffic were halted, Amtrak passengers would be bussed around John F. Stevens Canyon.. MDT would continue to close US Highway 2 temporarily during periods of avalanche danger or hazardous driving conditions, according to their hazardous conditions standard operating procedures (http://www.mdt.mt.gov/publications/docs/manuals/manual/chapt8c.pdf).

Why Alternative B is the Preferred Alternative

The solution to the railroad's concerns lies outside of the park boundaries in the form of snowshed protection, avalanche hazard forecasting, and railroad restrictions or delays during times of high avalanche risk. Based on the analysis in the document, A*valanche Risk Analysis in John Stevens Canyon, Essex, Montana* (Hamre and Overcast 2004), the construction of less than one mile of snowsheds offers the most effective avalanche protection for Amtrak passengers, BNSF employees, equipment, and freight. Once the recommended snowsheds are built, the need for operational restrictions or delays would be reduced or eliminated. Snowsheds would eliminate the uncertainty or consequence that is inherent with the use of explosives. The park views this alternative as the safest for Amtrak passengers, BNSF employees, and equipment in addition to having the least impact on park and forest resources.

Glacier National Park, together with Waterton Lakes National Park is the world's first International Peace Park, an International Biosphere Reserve and a World Heritage Site. The area of the park that BNSF has requested to use explosives has federally listed threatened and endangered species present, is within the park's recommended wilderness, provides winter recreation for park visitors and is important winter range for ungulate species. The park lacks sufficient scientific baseline data to measure "impairment" from the implementation of an explosive program for avalanche hazard reduction of this magnitude. Resource considerations combined with the risk of impairment to park resources and no commitment at this time from BNSF to construct less than one mile of snowsheds leads the park to select Alternative B as the preferred. No explosive use would be permitted in the park, except in the event that human lives or resources are threatened and all other options have been exercised by BNSF.

The newly approved NPS 2006 *Management Policies* provides guidance for park managers. Two policies in particular form the foundation for the selection of Alternative B. Policy 1.5 addressing appropriate use of park lands states

> In its role as steward of park resources, the … Service must ensure that park uses that are allowed would not cause impairment of, or unacceptable impacts on, park resources and values. When proposed park uses and the protection of park resources and values come into conflict, the protection of resources and values must be predominant.

Policy 1.4.7.1 addresses unacceptable impacts.

> The impact threshold at which impairment occurs is not always readily apparent. Therefore, the Service will apply a standard that offers greater assurance that impairment will not occur. The Service will do this by avoiding impacts that it determines to be unacceptable. These are impacts that fall short of impairment, but are still not acceptable within a particular park's environment. … unacceptable impacts are impacts that, individually or cumulatively, would
>
> - be inconsistent with a park's purposes or values, or
> - impede the attainment of a park's desired future conditions for natural and cultural resources as identified through the park's planning process, or
> - create an unsafe or unhealthful environment for visitor or employees, or
> - unreasonably interfere with an appropriate use, or the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park.

ALTERNATIVE C

Glacier National Park would issue a special use permit to BNSF for up to 10 years to conduct explosive avalanche hazard reduction in the park upon receipt of a commitment from BNSF to construct recommended snowsheds in that time period. If BNSF commits to fewer than the 5 new snowsheds and 7 snowshed extensions, the permit period would be adjusted accordingly.

This alternative would allow the limited use of explosives for hazard reduction for up to 10 years while snowsheds are completed by BNSF. If BNSF commits to build fewer snowsheds than are recommended by the *Avalanche Risk Analysis John F. Stevens Canyon, Essex, Montana* (Hamre and Overcast 2004), GNP would issue a special use permit for a period shorter than 10 years. An extensive natural resource monitoring program would be required for 15 years under a 10-year special use permit. If the special use period were shortened to less than 10 years, the resource monitoring program would be reduced accordingly. This program would be funded by BNSF and include monitoring of wildlife, noise, water, vegetation, soils, natural avalanche processes, and vegetation in GNP and FNF. BNSF would fund all avalanche hazard reduction methods and infrastructure related to this alternative including snowsheds. BNSF would reimburse all agency costs associated with the explosive use and monitoring programs. BNSF reimbursed NPS costs ($1705) for employee time and expenses of the explosive avalanche hazard reduction operation in February 2006.

Explosive delivery methods available for use would be hand charges, Avalauncher, helicopter drops, blaster boxes, or Avalhex-type systems. According to Hamre and Overcast (2004), this alternative would lower the avalanche risk considerably. The NPS, USFS and MDT would recommend the construction of snowsheds based on the projected reduction in avalanche risk according to Hamre and Overcast. BNSF would also build extensions on snow sheds 7 and 9 during the 10-year period. BNSF would also consider construction of new snow sheds first at locations that pose the greatest risk. Explosive use would not be permitted beyond the 10-year period. Map 2-3 depicts the action items under Alternative C. Tables 2-1, 2-3, and 2-4 provide a comparative explanation of action items for each alternative.

- BNSF would be permitted to use hand charges, Avalauncher, or helicopter delivery in starting zones in Burn Out, Jakes, and Second Slide.
- BNSF would be permitted to use hand charges, Avalauncher, Avalhex type systems, blaster boxes, and/or helicopter delivery in avalanche starting zones in Shed 5, Shed 7, Shed 8, Shed 9, Infinity, Shed 10, Path 1163, Shed 10.7 and Shed 11 avalanche paths for up to a 10-year time period. Avalhex or blaster box systems (locations Map 2-3) and their infrastructure would be temporary and would be removed once snowsheds are constructed.
- BNSF would commit to build snowsheds before the NPS issues a permit for explosive use in the park. The amount of snowshed construction would determine the amount of time that explosive use would be permitted. Permitted explosive use would be up to 10 years. Any avalanche paths not addressed by snowshed construction would be assumed an acceptable risk for the railroad. Snowshed construction is expected to follow the recommendations in the *Avalanche Risk Analysis, John F. Stevens Canyon, Essex* (Appendix A).

- The number of explosions is expected to be between 0 and 275 per year depending on annual avalanche cycles (See Appendix C). Projected annual explosive use would be reduced each year with the construction or modification of snowsheds. Explosives would not be permitted in avalanche paths with completed snowshed construction. Explosives would only be permitted during daylight hours.
- BNSF would fund resource monitoring before, during, and after the temporary use of explosives period. Resource monitoring would continue throughout the explosive use period and remain in place for five years after explosive use has stopped. Monitoring would be conducted for 15 years. If explosive use is permitted for less than 10 years, the amount of time monitoring would occur would be decreased accordingly.
- The NPS and USFS would jointly oversee the resource monitoring program. The NPS may change, limit, or stop the permitted use of explosives in the Park if unacceptable or unforeseen impacts occur.
- Montana Department of Transportation would temporarily close US Highway 2 during explosive use to prevent vehicles from being hit by triggered avalanches.
- The immediate project area (2,750 acres) from the highway to the ridge in GNP would be temporarily closed to recreational use during explosive procedures to protect winter recreationists (Map 2-3).
- Avalanche signal wire could be removed or continue to be used in avalanche paths without snowsheds or in snowshed bypass areas.
- Avalanche detection systems such as infrasonic detection systems, geophones, and/or Doppler radar could be installed in avalanche paths. These devices, if used, would be installed on BNSF right-of-way land or runout zones.
- BNSF avalanche forecasters would monitor avalanche conditions and make recommendations to BNSF depending on hazards in specific avalanche paths.
- BNSF avalanche forecasters would monitor and report on the effectiveness of explosive control during the 10-year period. The monitoring would be conducted according to the standardized guidelines published by the American Avalanche Association and the USFS in *Snow, Weather, Avalanches: Observational guidelines for avalanche programs in the United States*.
- Snowslip Weather Station and Pike Creek Snotel would be used for forecasting and avalanche hazard determination. Snowslip Weather Station would be removed after the permitted explosive use period.
- A new weather station at elevation 4600 feet would be installed near milepost 189.8, at the MDT maintenance facility along US 2 on NFS land.
- A snow depth sensor would be installed on NPS land at elevation 5600 feet on the ridge between Shed 7 and Shed 6 avalanche paths.
- BNSF would temporarily stop or delay train travel through the John F. Stevens Canyon when avalanche danger is high, explosives are used, or avalanche debris crosses the tracks. High avalanche danger is defined by snow instability, natural avalanche activity, and weather conditions causing instability and natural avalanche activity.