

Best Management Practices Road-Stream Crossing Removal



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December, 2001

Best Management Practices

Stream Crossing Removal

Definition

Excavation of road and landing fill from road - stream channel crossings and stabilization of excavated materials. Stream channel bed, banks, and adjacent slopes are restored to their pre-crossing configuration. Longitudinal stream gradient is reestablished through the crossing site.

Synonymous Terms

Road-stream crossing removal, Humboldt crossing removal

Purpose

To prevent erosion of road crossing fill and to prevent diversion of stream flow onto adjacent road surfaces. Erosion of stream crossing fill causes direct sedimentation to the drainage network. Runoff diversion at stream crossings can cause severe gullying on roads and slopes or cause mass movements if flow is directed onto interfluvial areas. Runoff diversions create a direct linkage between streams and roads, which increases sediment delivery to the drainage network. Stream crossings can divert runoff to adjacent sub-watersheds causing increased flow, bank erosion, channel migration, and inner gorge mass wasting.

Planning Considerations

- General Plan compliance
- Anticipated future road use
- Access to nearby rehabilitation sites
- Access for future fire protection, resource management, and backcountry patrol
- Accessibility to site with heavy equipment and service vehicles
- Offsite disturbance caused by accessing site
- Design and construction of diversion structures or sediment retention structures in affected channels that are flowing year-around
- Availability of suitable locations for crossing fill either nearby or offsite
- Removal of large woody debris and boulders from crossing
- Disposal of culverts
- Stockpiling of woody debris for post-treatment mulching
- Potential for road to trail conversion

Construction Specifications

- The excavator shall prepare the site by first removing all trees and brush growing on the cutbank, roadbed, and embankment fillslope of the adjacent road sections. Trees and brush growing on the crossing fill are also removed. Mulch shall be stockpiled on the top of the adjacent road cutbanks or elsewhere in the crossing excavation area. Mulch may be stockpiled in piles but shall be left accessible to the excavator when earthmoving tasks are complete. Trees growing in undisturbed soil that were partially buried by fill may be left standing, however all fill shall be excavated away from around the base. Care should be taken not to damage roots. An excavator mounted vegetation masticator may be used to remove trees and brush. Tree boles shall be left a minimum of 24" high for later extraction with the excavator or dozer. If a masticator is used, a dozer may be employed to accumulate and pile ground mulch for use on finished surfaces.
- If the stream is flowing, water is diverted away from excavation areas to reduce turbidity. Where channel widths are wide enough a berm is constructed to divert water away from the work area. Where channels are narrow, a small diversion dam is built upstream and stream flow is piped around the worksite and discharged into the stream below the worksite.
- At failed crossings, a small road bench is reconstructed along the upstream end of the crossing to allow access to both sides of the crossing. A minimal amount of fill is used and streamflow (if present) is piped around the site or a culvert is installed to convey streamflow under the temporary road.
- Following clearing operations, a dozer equipped with rippers shall decompact the inboard ditch and the cutbench portion of the adjacent road sections to a minimum depth of 12 inches. The cutbank shall be stripped of all organic accumulations using the dozer or the excavator or a combination of the two. Organic material shall be incorporated into the fill material and used to recontour the cutbench. Small, dispersed organic material shall be mixed and incorporated into the fill material and used to recontour the cutbench. Larger accumulations of organic debris shall be gathered by the excavator and stockpiled with trees and brush removed from the roadway.
- If stable areas exist along the adjacent road cutbench, the dozer begins pushing the crossing fill into the cutbank in maximum 6-inch lifts. The dozer continues to push material out of the crossing compacting it in lifts until the material becomes too steep on which to operate, the dozer reaches the local Ordinary High Water elevation, or no more fill is available in the crossing. As the dozer cuts crossing fill it leaves a berm on the downstream edge to prevent material from being sidecast downslope toward the stream.
- Cutbanks exposing seeps or springs shall not be recontoured. Instead, the crossing fill shall be exported to dry section of the road farther from the crossing. An outsloped cutbench shall be left adjacent to the stream crossing if wet areas are present.
- As the dozer begins the crossing excavation, the excavator positions itself at the downstream edge of crossing and begins removing fill and placing it where the bulldozer can push it to the storage area. In crossing excavations where stream flow is present, the excavator always works from downstream extent of excavation to the upstream extent to prevent pooling and uncontrolled release of water and sediment. If the adjoining road is not suitable for material storage, the excavator removes the crossing fill and loads directly into a dump truck, and material is end-hauled to a stable location.

- The dozer and excavator continue to work in tandem until all crossing fill on the adjacent slopes has been removed. The excavation should be designed to match the slopes and banks upstream and downstream from the crossing. In cases where the failed crossing includes a large inner-gorge gully or has incised below pre-disturbance stream grade, it may be necessary to lay the banks back by digging into non-fill material.
- The excavator makes final adjustments to the excavated stream crossing. The final surface is smoothed by back dragging with the dozer or the back of the excavator bucket. Trees and brush removed prior to excavation are then spread over the surface as mulch. Logs and rocks should not be placed in the excavated channel because this causes lateral migration resulting in bank erosion. Logs should be placed on the channel margins or can span the removed crossing. In some rare cases, instream structures may be constructed to provide grade control or to stabilize an exhumed bend in a channel planform.
- Road sections immediately adjacent to stream crossings should not be fully recontoured. Instead, the fill is tapered toward the crossing and some cutbank is left exposed. This reduces the slope on each side of the crossing and reduces the chance for a post-treatment slope failure that will deliver sediment directly to the drainage network. In crossings with gentle sideslopes, cutbanks can be fully recontoured if post-treatment failure is not considered a significant hazard.

Mitigation Measures:

Aesthetics

Eliminating stream crossings and restoring the topography to the natural conditions that existed prior to the road construction will improve aesthetic values. Short-term effects to local forest and prairie settings will occur as vegetation is disturbed for rehabilitation work. Exposed earth and dried vegetation may be visible for several years following treatment. Typically, prairie settings are more widely visible, but recover within several months. Grass reoccupies the disturbed area during the first growing season following construction. Forest settings take longer to recover but have a limited visibility and typically do not affect park viewsheds.

For safety reasons, work areas are closed to the public during construction. Therefore, the general public will not view temporary visual effects at construction sites. Interpretative signs shall be posted with information about the project at the nearest public use area and at all access points. After the closures are lifted, the public will be able to view the work locations, however, the final project condition closely matches the pre-disturbance landform and quickly blends into the surrounding area as duff and herbaceous plants cover the exposed soil. The interpretive panels also help the public visualize the final appearance of the recontoured road.

Trees are removed and scattered on exposed soil as mulch during road recontouring work. This can present a negative aesthetic effect, particularly in a park setting. The effect is transitory, however, as vegetation recovery is generally rapid in the north coast region. Because of the thick under-story vegetation and dense stands of trees growing adjacent to work sites, work will not be visible from most public use areas.

Air Quality

Diesel exhaust and dust will be produced as part of the heavy equipment work. Air quality in the vicinity of the work is generally high, unless wildfires or prescribed burns are occurring, and the products of the heavy equipment will be rapidly dispersed. The equipment will be moving through the project sites so that any individual site will not receive prolonged exhaust.

Heavy equipment operations may expose workers in the project area and vicinity to exhaust fumes and dust. Heavy equipment operators shall be cautioned to avoid prolonged exposure to exhaust and dust. The cabs of heavy equipment shall be kept in good serviceable condition to provide protection from exhaust and dust. Seals, windows and doors should be kept in good condition to provide protection when necessary. Detected exhaust leaks shall be repaired immediately to protect workers from exhaust exposure and reduce fire hazard. Project inspectors can position themselves upwind of heavy equipment operations to reduce exposure to exhaust and dust. Dust mask may also be used by operators and inspectors to reduce inhalation of particulates.

Heavy equipment engines and hydraulics generate heat during the work. However, sources of high heat are shielded by equipment covers and do not expose nearby object to high heat. The effects of residual heat diminish rapidly within a short distance of the equipment. Heat shields shall be maintained in good serviceable condition to prevent high heat exposure. The removal of some trees and brush from the roads prior to removal will allow increased sun into the sites and may increase daily temperatures on the soil surface. However, rapid natural revegetation is expected due to fertile soils, summer fog, and high winter rainfall in this area. Heat generated during road recontouring work will not affect local air temperatures, or regional or global climate.

Biological Resources

A primary goal of road-stream crossing removal is the improvement of habitat for, and protection of threatened, endangered, and rare species. Short-term adverse effects will avoid any negative effects to any listed species to the maximum extent practicable. All appropriate design features and mitigation measures shall be incorporated into project planning. Projects shall be conducted in compliance with all applicable State and Federal threatened and endangered species protection laws and regulations.

The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) shall be requested in writing to provide Technical Assistance under Section 10 of the Endangered Species Act (ESA) in cases when there is a question about whether a specific project has the potential to effect threatened & endangered (T&E) species. Under Section 10, NMFS and USFWS can provide assistance in project planning and design to avoid effects to T&E species. At the State level, the California Department of Fish and Game (CDFG) may also provide informal consultation on projects that may effect T&E species.

When effects to T&E species cannot be avoided by design and mitigation an Incidental Take Permit shall be requested under Section 7 of the ESA. A Federal nexus must exist as a requirement for an Incidental Take Permit from a Federal agency under Section 7. If no Federal nexus exists, consideration shall be given to the development of a habitat conservation plan (HCP).

All projects shall be reviewed by the District's State Park Senior Resource Ecologist (SPSRE) to ensure protection of natural, cultural and historical resources. Site visits including the project manager, State Park Senior Resource Ecologist shall occur to develop alternatives that do not negatively affect State Park resources.

The SPSRE shall work closely with the project manager to implement the following practices to protect biological resources:

Plants: Qualified botanists shall conduct rare plant surveys on all stream crossings planned for removal prior to project implementation. If any rare plants are located, they shall be avoided to the maximum extent practicable unless greater resource protection needs exist. Greater resource needs

include: eliminating stream diversions, stabilizing slopes that are likely to fail, and eliminating concentration of flow on roads. Rare plants that cannot be avoided may be salvaged and transplanted onto appropriate stable ground.

Trees: All trees, regardless of DBH (diameter breast height), growing in road crossing or adjacent road embankment fill will be removed as part of the stream crossing removal process. Trees greater than 24 inches DBH buried by fill that predate crossing or road construction will be retained. Limbs of these trees may be removed if required for access. Small trees, less than 24 inches DBH, buried in fill that predate road construction will be left whenever practical. Equipment operators shall be required to avoid striking retained trees to minimize damage to the tree structure or bark. Tree roots shall be avoided, as the excavations will not be deeper than original ground surface. Some advantageous roots may be damaged that have grown into embankment fill.

Fish: Stream crossing removal projects shall occur in the dry season when stream flows are at a minimum or non-existent. Stream crossing excavations shall be designed to limit negative effects on water quality to the maximum extent practicable. If the stream is flowing, water shall be diverted away from excavation areas to reduce turbidity.

Where channel widths are wide enough a berm is constructed to divert water away from the work area. Where channels are narrow, a small diversion dam is built upstream and stream flow is piped around the worksite and discharged into the stream below the worksite. In streams with flow less than 2 cubic feet per second (cfs) Coir “bio-logs” or silt fence shall be placed perpendicular to flow downstream of crossing removals to capture suspended sediment. In streams with flow greater than 2 cfs silt curtain/fence shall be constructed to separate the flow from the excavation area. In some cases, stream flow shall be diverted around the construction site using a gravity feed system.

On roads where potential sediment delivery to streams exists, construction activities after October 15th shall proceed only after consultation and approval by NMFS. Work in the rainy season shall occur during dry spells with materials for erosion control on-site at all times. Work shall be conducted so that no more than one-half day’s work is active at one time and all work shall be completed by the end of each day. When winterization of access roads is required, all access road shall be winterized prior to any additional earth moving tasks.

Any soil disturbance adjacent to stream channels shall receive evenly distributed mulch coverage with masticated brush and trees to reduce sheet erosion. Mulch generated during the clearing phase of the rehabilitation work shall be used to the maximum extent practicable.

Birds: Potential habitat for the State and Federally listed marbled murrelet exists in various locations throughout North Coast Redwoods District. To avoid noise disturbances, any work within ¼ mile of the suitable habitat for murrelet shall take place after September 15th. Potential habitat for the Northern Spotted Owl exists in various locations throughout North Coast Redwoods District. To avoid noise disturbances, work within ¼ mile of suitable roosting and nesting habitat for Spotted Owl shall take place after July 10. In most cases, habitat trees shall not be affected by road recontouring, however, if trees need to be removed that are potential Owl habitat, protocol surveys shall be conducted prior to construction. No habitat disturbances shall occur within ¼ mile of a nesting site.

The Senior State Park Resource Ecologist shall assess each project for the presence of “fully protected” bird species listed under the California Fish and Game Codes. If the potential exists for the presence of these species, USFWS and CDFG consultation shall occur to develop avoidance measures.

Operations shall occur prior to these dates only if approved surveys indicate the absence of protected species or, incidental take permits are obtained from USFWS. The ¼ mile distance rule shall be reduced if geographic features such as a ridge separate the site from suitable habitat (See Technical Assistance Report, April 2001). On sites where background noise is greater than the noise caused by road recontouring equipment, such as adjacent to a major highway, construction may occur prior to the above dates because noise disturbance is no longer an issue.

Amphibians: Qualified biologists shall survey for the presence of suitable habitat for sensitive amphibians and reptiles at stream crossing removal locations. Amphibian habitat shall be avoided wherever practicable. At stream crossing removal sites, some loss of non-listed species may occur if they are within the road prism subsurface but not sufficiently deep in the crossings to avoid being excavated. However, once road fill is removed and drainage is restored, habitat quality both in the crossing vicinity and in the watershed overall will be greatly increased. If listed species are located and avoidance is not practicable, incidental take authorization shall be obtained from CDFG or USFWS.

If rare species are located the project shall be redesigned to preserve individuals and their habitat. If T&E species are encountered the same process outlined under biological resources above shall be used to avoid impacts, obtain a take permit or develop a HCP.

Final reports are required on all biological surveys conducted by consultants or contractors. Consultants shall be requested to list any locally designated species or species of concern, should they exist in the project area.

Exotic Plants: Freshly disturbed ground created by heavy equipment during road treatments may provide habitat for exotic plant species. Heavy equipment may also introduce exotic plant seeds or spread existing seed into the landscape. To minimize potential effects, all heavy equipment shall be pressure washed prior to entering the park or moving from a known infested area within the park to a non-infested area. Anti-fungal wash agents may be specified if the equipment has been exposed to any pathogen that could affect park resources. All heavy equipment contracts shall specify pressure washing of the machines prior to entering the park. Park equipment operators are required to pressure wash equipment before transporting to different units within the District.

In areas where exotic species may exploit disturbed soils and dominate the revegetation, treatments using mulch, seeding, herbicide applications or combinations thereof may be used to reduce the invasion of exotic species.

Wetlands: Natural wetland habitat such as marsh, riparian, and vernal pools shall not be filled by road-stream crossing removal projects. Some work will occur in riparian corridors at stream crossings. However, equipment will be working within existing road alignments at the crossings and will only affect previously impacted areas. Equipment shall remain on existing road alignments and crossing fill areas to the maximum extent practicable. Equipment may travel off road only when no other alternative is available and after the project inspector and biological consultants have reviewed the route. Where appropriate, the US Army Corps of Engineers shall be consulted for permitting work in the vicinity of wetlands.

Wildlife Corridors: Wildlife dispersal or migration corridors may be temporarily altered from the natural migration routes during the heavy equipment work because of daytime noise effects. However, there may be alternative routes adjacent to the work areas suitable for their use. Stabilizing the landform will reduce future potential landslides and large gullies that inhibit wildlife movement.

Cultural Resources

Stream crossing removal projects require the movement of earth that could have adverse impacts on significant cultural resources. Therefore, review under Public Resources Code 5024 is required to identify any significant cultural resources within the area of potential effect for a proposed project. In the event that avoidance of a cultural resource is not practicable, mitigation measures to decrease the impacts of a crossing removal project to less than significant shall be proposed. Construction monitoring shall take place to decrease the potential for impacts to cultural resources in areas of moderate to high sensitivity during construction.

In the event that previously undocumented cultural resources are encountered during project construction (including but not limited to dark soil containing shellfish, bone, flaked stone, or groundstone, or deposits of historic trash), work within 100 feet of that location shall stop until a State qualified archeologist has evaluated the area. If any human bones or remains are uncovered, work shall stop until the County Coroner, State qualified archeologist, and appropriate Native American representatives have evaluated the find. Effects to sacred or religious sites shall be avoided to the maximum extent practicable. If a sacred or religious site exists in a project area, formal State Historic Preservation Office consultation shall occur as well as review by the Native American Heritage Commission.

Some road stream crossings may have potential cultural or historical significance. Therefore, all stream crossings scheduled for removal shall be reviewed to determine their historical significance. Individual crossings that are eligible for listing with the OHP shall be preserved and protected to the maximum extent practicable. All stream crossings that are proposed for removal have already shown evidence of deterioration or have potential to fail in the future.

Geology /Soils

Stream crossing removal reduces mass wasting and surface erosion by eliminating the anthropogenic cause of these problems such as roads, landings, and stream crossings. Treatments are designed to restore natural fluvial and riparian topography and surface hydrology thereby increasing the stability of the rehabilitation sites. Inspectors trained in landform rehabilitation conduct direct oversight of the work to ensure that the treatment designs are complete, have a stable geometry, and blend well into the surrounding natural topography.

Minor slope adjustments and surface erosion may occur after treatment, as soil is re-exposed during the stream crossing removal. Bare ground shall be mulched with vegetation removed during the work to the maximum extent practicable to minimize surface erosion. Stream crossing removal will significantly improve the stability of the work sites and reduce surface erosion from the existing condition.

Heavy equipment operators shall be cautioned to minimize their exposure to unstable slopes that may occur naturally or result from the earthmoving process. Inspectors shall continually evaluate slope geometry and caution operators if unstable conditions are indicated. A qualified geologist shall review stream crossing removal sites during project planning to determine if any geologic conditions exist requiring additional assessment or alteration of prescriptions. If unique features do exist, a licensed geologist shall conduct a geologic assessment/investigation.

The NCRD lies within a highly active seismic region. Portions of the Northern Coast Ranges Fault System (San Andreas Fault Zone), the Mendocino Triple Junction, and the Cascadia Subduction Zone lie within or near the NCRD. Exposure to strong ground shaking is possible throughout the

District. Seismic events will expose workers to direct effects from ground shaking, and possible secondary effects from ground rupture, seismically induced mass wasting, and seismically induced tree failure. However, rehabilitation workers are not exposed to a higher level of hazard than those in other settings. The time-weighted-average exposure to seismic hazards is less at rehabilitation site than it would be in an urban or suburban setting. Due to the remote location of most rehabilitation projects, seismic effects are unlikely to affect park visitors or staff. Conditions for tsunami generally do not exist because road recontouring locations are generally inland from water bodies. No volcanic hazards exist in the project vicinity.

Subsidence of land is not anticipated to be a problem at stream crossing removal locations. Soil and geologic conditions that could result in subsidence such as expansive soils and soluble bedrock do not exist in the NCRD. Stream crossing excavations will not affect unique geologic or physical features.

Hydrology / Water Quality

Existing (altered) drainage patterns will be restored to pre-disturbance patterns. In some cases where pre-disturbance patterns cannot be restored, rehabilitation work may require the realignment of a stream segment. To ensure that channel stability will be maintained, project planners will establish new drainage segments only after thorough review by a qualified geologist/geomorphologist or hydrologist. Reconnecting diverted streams to their natural flow pattern will increase discharge in abandoned channels. However, significant geomorphic adjustments are not likely to occur due to the increased discharge because the reoccupied channels had originally formed under the post-treatment flow regime. Offsite effects of reestablishing pre-disturbance drainage patterns and discharge shall be evaluated to ensure increased discharge will not adversely impact fluvial geomorphic functioning downstream.

Water quality will be improved as watershed rehabilitation is implemented within an impacted watershed. However, following rehabilitation work a short-term increase in suspended sediment and bed load will occur downstream of the rehabilitation sites that are directly adjacent to streams. Sediment is delivered to the stream from ravel along the adjacent slopes and minor amounts of soil lost downslope during excavation. These effects are limited to the first winter following treatment and in most cases are limited to the first runoff-generating event of the winter. The affect on aquatic habitat is observed immediately downstream of the rehabilitation sites but does not typically extend more than several hundred feet downstream. Sediment delivery from road segments not directly adjacent to streams would be limited to highly mobile debris flows or torrents, which have not been observed during post-treatment project reviews.

In larger subwatersheds rehabilitation work is typically spread over a period of several years so that short-term (post-treatment) water quality effects are not experienced simultaneously. Long-term transport rates of suspended load and bed load will be higher without rehabilitation work, and high volume short-term pulses of sediment typically occur during extreme storm events.

The cumulative effect of removing stream crossings on water quality will be a reduction in suspended and bed load transport, improved fluvial-geomorphic functioning, and an improvement in the aquatic habitat throughout the drainage network.

Shallow subsurface flow will be influenced by changes in surface drainage patterns and/or changes in porosity of the soil at rehabilitation sites. Changes in the direction or rate of shallow subsurface flow may be influenced by changes in surface drainage patterns. Stream crossing excavation work

may intersect the water table. However, minor amounts of turbidity introduced at the excavation sites are not likely to have a significant effect on groundwater quality. No wells exist that provide direct conduits to the groundwater supply.

Stream crossing removal projects will not have a significant affect on the amount of groundwater available for public water supplies. The water table adjacent to the crossing excavation may be lowered as saturated crossing fill is removed from the stream channel, however this effect will be localized around the crossing site. Project planning shall identify public water supply and Park water systems that may be affected. Persons responsible for the maintenance of these water systems shall be consulted and if negative effects are anticipated, mutually agreeable mitigations shall be developed.

Hazards & Hazardous Materials

Failure of, or leakage from, vehicles or heavy equipment could result in the release of hazardous substances (primarily petroleum based products) to the ground or water. Equipment is required to be leak free throughout rehabilitation projects. Leaks that develop are repaired immediately in the field or work is suspended until repairs can be made. Spill kits are maintained on site in the event of accidental spillage. Appropriate agencies shall be notified in the event of significant spillage.

The NCRD has adopted a general safety protocol for backcountry heavy equipment operations. The general protocol outlines broad safety issues common to all projects and presents guidelines on how to address those issues. The general protocol also directs project managers to develop a project specific safety plan for each rehabilitation project. The plan shall identify any existing emergency response plans. The project shall be designed and implemented to avoid any conflicts with existing plans and to avoid any increase in emergence response time.

Workers spend most of their work hours in remote wildland settings and may be exposed to natural hazards consistent with that environment (e.g., wild animals, insects, noxious plant, lightning, wind, etc.). All employees are issued first aid kits and are trained how to respond to anticipated and unanticipated incidents. Employees are asked to disclose any sensitivity that might affect their employment tasks.

Heavy equipment can get very hot during the warmer part of the work season; this equipment is sometimes in close proximity to flammable vegetation. Equipment that is not properly outfitted can generate sparks from exhaust systems. Friction between metal parts crushing rocks could also generate sparks. Spark arrestors or turbo-charging (which eliminates sparks in exhaust) and fire extinguishers are required for all heavy equipment. Heavy equipment itself can be used for fighting fire in the backcountry. The safety plan developed for each project is reviewed by all project staff and includes job site characteristics to reduce the potential for fire. Park staff is required to have a State Park radio on site, which allows direct contact to California Department of Fire Protection and centralized dispatch center. Construction crews shall be required to park service vehicles away from flammable material such as dry grass and brush. At the end of each workday, heavy equipment shall be parked over mineral soil to reduce the chance of fire.

Land Use / Planning

Project design shall include review of any General Plan that has been developed for a park unit. The General Plan shall be used to guide the general direction and level of rehabilitation efforts. Any reference to a project in a General Plan shall be included in the CEQA document. Projects shall not be implemented if they are in conflict with a General Plan.

All projects shall be in compliance with the Resource Management Directives of California State Parks and all State and Federal environmental laws.

Projects shall be compatible with existing land use in the vicinity of projects. The existing land use on State Park property includes recreation and preservation. Stream crossing removal will not affect agricultural resources. Agricultural resources on adjoining property will benefit from stream crossing removal by improving water quality and quantity. Illegal agricultural activities have been discovered on State Parks during planning and inventory phase of watershed rehabilitation projects. All illegal uses are immediately reported to State Park law enforcement officials. Information signs are placed at all points of entry into project areas prior to implementation, informing the public of the upcoming project to help deter illegal agricultural uses.

In general, established communities do not exist within the boundaries of any North Coast Redwood Parks. Stream crossing removal will not disrupt or divide the physical arrangement of an established community. If a project is identified in an established community, alternative transportation routes shall be developed to mitigate the removal of road stream crossings. Community members shall be notified of projects that may have any effect on the community and agreements shall be developed that are mutually agreeable.

Mineral Resources

Stream crossing removal will not conflict with adopted energy conservation plans. The projects will not involve wasteful and inefficient use of non-renewable resources. Heavy equipment shall be used in as efficient manner as possible and project designers shall continue to research and implement the most energy efficient techniques. Stream crossing removal will not affect availability of a known mineral resource that would be of future value to the region and residents of the state.

Noise

Noise levels will temporarily increase at the work site, although the noise generally diminishes rapidly with distance. Equipment operation at sites close to campgrounds or residences shall be limited to daytime hours between 08:00 to 16:00 Monday through Friday.

Workers in close proximity to the heavy equipment are exposed to high noise levels. Workers shall be advised to wear ear protection when in close proximity to the heavy equipment. Earplugs shall be provided to all workers and extra earplugs shall be stored in all vehicles and equipment. All operations are in compliance with OSHA regulations.

Population / Housing

Stream crossing removal will have no cumulative effect on regional or local population projections. Stream crossing removal will not induce growth of human populations or communities. Stream crossing removal will not displace existing housing or affect affordable housing.

Public Services

Stream crossing removal may affect fire protection abilities because the abandoned roads will require additional heavy equipment time to re-open a road to vehicle traffic. Most stream crossings proposed for removal are already closed due to crossing failures and natural revegetation. A network of service roads shall be maintained throughout the North Coast Redwoods Parks to aid in fire suppression.

If stream crossing removal is planned for a road that is currently open to vehicle traffic, park rangers will be consulted to determine appropriate mitigation measures to maintain law enforcement access.

However, stream crossing removal sites are usually along abandoned roads covered with thick vegetation and numerous road failures. Therefore, stream crossing removal will not affect emergency access.

Recreation

Stream crossing removal projects will not directly affect campground facilities within park units. Occasionally if campsites are located close to or downslope of a rehabilitation site, the sites may be temporarily closed for public safety. Backcountry stream crossing removal areas will be closed to the public temporarily during the construction season to protect visitors from worksite hazards. All trails and roads within the Park backcountry that are not within the project area will remain open during the summer work season. Park visitor services and ranger staff shall be informed of any area closures and will affect visitors or other park operations. Area closure signs shall be posted at all access points to projects and at campground and visitor center kiosks. Official closure notices shall be obtained and posted during the project implementation and post-treatment recovery phases.

Transportation/Traffic

Traffic by workers to and from the work sites will be required on County roads and State highways. Given logistical constraints of the amount of heavy equipment work that can occur simultaneously in the project the maximum number of round trips required per day will be less than 10 in any given park, which is insignificant compared to current levels of traffic.

Heavy equipment is generally transported on a lowboy transport and is classified as a wide load on State highways. All equipment transport operations shall be in compliance with State and local laws and all permits shall be obtained as necessary. Pilot trucks shall be assigned to accompany the transport as required by State and local laws. Transportation of heavy equipment is common on roads and highways in this region due to logging and gravel mining industries.

Parking capacity will not be affected by stream crossing removal projects.

Stream crossing removal does not increase traffic hazards to the public. Stream crossing removal eliminates road use and the hazards associated with them.

Stream crossing removal will not result in conflicts with adopted policies supporting alternative transportation. They will not result in effects to rail, waterborne or air traffic.

Glossary for Best Management Practices

aggrade - the filling of a stream channel with sediment. This usually happens when the supply of sediment is greater than the stream is transporting. Compare to “degrade” and “graded stream.”

alignment - the area affected by a road or trail including the fill slopes, road bench, and cut bank. Also a linear representation of features on a map such as a stream channel.

curvilinear - a curving line. Refers to a meandering trail that curves around boulders and trees following contours across the land at a flat or oblique angle.

cutbench - the portion of a roadway that has been cut into bedrock or native soil. Compare with embankment.

decommissioning - the treatment of a road to eliminate diversion potential during periods of nonuse. A road is typically decommissioned when the road will not be used for a period of time but may be used some time in the future. Decommissioning includes the removal of stream crossing fill and partially recontouring or out sloping road segments between crossings.

degrade - refers to the erosion of a stream channel. This usually happens when the supply of sediment is less than the amount the stream is transporting. Compare to “aggrade” and “graded stream.” Also refers to poor water quality or a disturbed watershed function.

ditch memory - subsurface water flow along a former drainage ditch after road removal is completed. This often occurs when ditches have not been ripped. Also see memory.

ditch relief culvert - see road cross drain

diversion potential - the potential for water to divert down a roadway if a stream crossing becomes plugged. Stream crossings with diversion potential have a high likelihood of contributing massive volumes of sediment to streams if the diversion causes gullies or landslides. Diversion potential is reduced by construction of a fail safe crossing (critical dip with rock armor) or by complete stream crossing removal.

drain lens - buried coarse aggregate wrapped in filter fabric used to drain subsurface water from springs or seeps.

duff - partially decayed organic material composed of needles, leaves, and twigs on the forest floor.

embankment - fill excavated from the cutbench and used to construct the outboard road bench. This is often referred to as the fill slope or outboard fill material.

endhauling - the transportation of excavated material to a stable storage location using a dump truck.

energy dissipater - material such as rock riprap or a structure made of logs, metal pipe, or poured concrete that is used to reduce the energy of flowing water below culvert outlets or dips.

erosion control - activities that prevent soil from being detached and moved down slope including, but not limited to, road removal, revegetation, mulching with brush, out sloping, and compaction of unstable fill.

Glossary for Best Management Practices

(continued)

erosion prevention - cost effective techniques used to prevent erosion before it happens.

fail safe crossing - a stream crossing that has been constructed in a way that has no potential for diversion. The ultimate fail safe crossing would include an oversized culvert, road approaches that slope upward in both directions, a critical dip that drains back into the stream, energy dissipaters, brush rack, and a headwall.

fall line - an imaginary line on a sloped surface that follows the steepest angle. You can think of the fall-line as the line that would be made by a ball rolling down the slope.

fill - material used to construct roads and related structures. Fill can include soil, rock, and large organic debris.

full recontouring - the treatment of a road that completely eliminates (obliterates) the road from the landscape. Full recontouring is accomplished by recovering all available fill and burying the cutbank until the surrounding terrain is fully matched. This type of treatment is also referred to as road removal or road obliteration. See obliteration.

geomorphology - the study of the earth's surface and the processes that shape it. Geomorphology is closely related to geology.

geomorphologist - a person who studies geomorphology.

grade - the natural, proposed, or planned ground surface. Usually grade is set to match the surrounding topography.

graded stream - a stream that, over a long period of time can move as much sediment as is supplied to it. Compare to "aggrade" and "degrade."

gradient - the measurement of the angle along the length of a road or a stream. This term is often confused with grade (see grade).

gully - a steeply sided channel caused by concentrated surface runoff erosion. Gullies can usually be identified by their location away from natural stream valleys.

Humboldt crossing - a stream crossing constructed with logs set parallel to the stream channel and covered with fill.

hydrology - the science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rock, and in the atmosphere. This term is often confused with hydrogeology, which is the science of groundwater.

inboard - refers to the upslope side of a road, trail or other feature.

inboard ditch - a drainage ditch cut along the inboard side of the roadbed to intercept drainage from the slope above or small streams. Inboard ditches usually direct their water through a culvert that crosses under the road.

Glossary for Best Management Practices

(continued)

large woody debris (LWD) - also known as large organic debris (LOD), refers to logs and stumps found in stream channels, road fills, etc., having a diameter greater than 12 inches and a length greater than 6 feet.

legacy road - a road originally constructed for another purpose that remains in use. Many of today's park roads were originally constructed as logging roads but now serve as backcountry access roads.

mass wasting - a general term that includes many types of massive earth movements. These include rock slides, debris slides, debris flows, and earthflows, etc.

meander - a series of gentle curves in a stream, road, or trail.

memory - a subsurface zone where water will preferentially flow due the presence of a gully or inboard ditch buried in recontoured fill. Also see ditch memory.

obliteration - to completely remove the road feature from the landscape. This is accomplished by full recontouring. See full recontouring.

outboard - refers to the downslope side of a road, trail or other feature.

operator - the person operating heavy equipment or other machines.

outsloping - the treatment of a road to eliminate diversion potential along the roadbed during road reengineering. Outsloping includes excavation of some of the road fill along the outboard edge of the road and placing it against the cutbank to eliminate the inboard ditch and provide drainage toward the outside of the road. Outsloped roads are commonly graded and covered with compacted road base to harden the surface.

partial recontouring - similar to outsloping, this term is reserved for roads that are to be removed or decommissioned. The partial recontour often has a steeper cross slope on the former roadbed to ensure proper drainage. Partially recontoured roads are not matched at the top of the cutbank like fully recontoured roads.

permeability - a measure of the rate at which water can pass through soil.

ripping - decompaction of the soil by means of rippers mounted on the rear of a dozer.

roadbed - the surface of the road where driving takes place. The roadbed extends from the inboard ditch or cutbank to the outboard slope break or berm.

road cross drain - a drainage structure which utilizes a culvert to direct water from an inside ditch to an area beyond the outer edge of the road fill.

roadway - the corridor including the cutbank, the inboard ditch, the roadbed, and the embankment.

rolling dip - a shallow dip designed to convey water off of the road surface while allowing vehicles to pass at reduced speed. Rolling dips should be located where stable landscape features exist that can carry runoff without causing erosion.

Glossary for Best Management Practices

(continued)

runoff - rainwater flowing on the surface of the ground. Runoff can be generated by rain falling on saturated ground or from heavy rain that cannot soak in fast enough.

sediment - Silt, sand, clay, and gravel that is moved by water and deposited at some location.

sediment control - activities that filter dirt out of water, including silt fence and sediment retention basins.

slope angle - the angle of the hill slope measured in percent along the fall line.

soil - clay, silt, sand, compost, air, water, and weathered rock mixed in various proportions. Soil consists of horizons or layers that display different amounts of weathering and fertility.

spoils – soil and organic material that is excavated from stream crossings or road embankments that is used for recontouring or can be end-hauled to a stable storage location.

stream crossing - a constructed road section across a natural stream. There are many types of crossings such as bridges, culverts, Humboldt (see definition), and fill crossings.

surfacing – rock aggregate or paving that is placed on the road surface to reduce erosion and weather-proof a road for winter use.

through-cut – a portion of a road that has cutbanks on both sides with drainage flowing down the road or inside ditch.

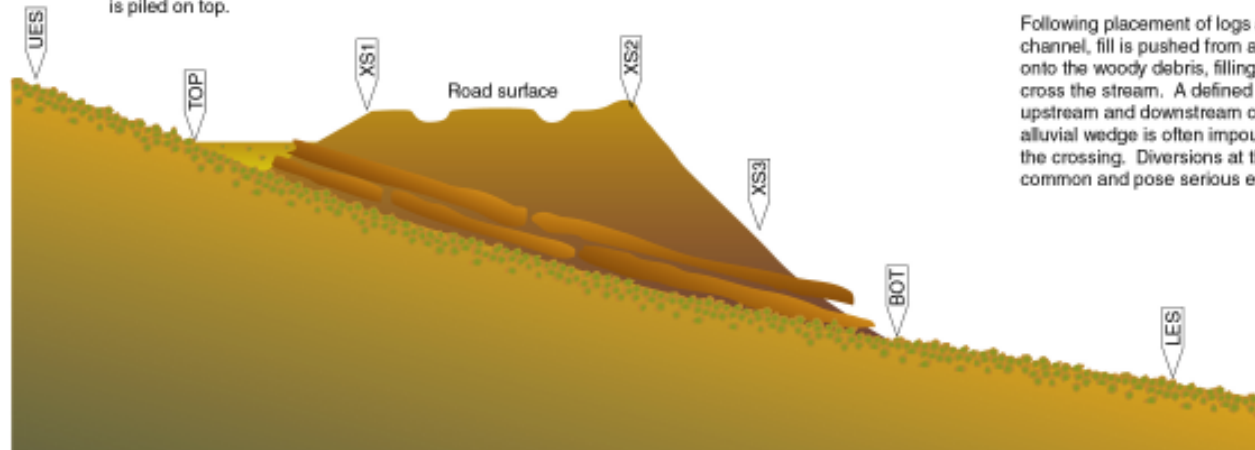
topography - the natural shape of the land's surface.

topsoil - the uppermost layer of decayed organic matter, seeds, soil, and microorganisms.

trash rack – a structure located upstream of a culvert inlet designed to trap floating debris to prevent the culvert from becoming plugged.

Humboldt Stream Crossing Excavation Longitudinal Profile Cutaway

Logs, stumps, and brush are pushed into the channel to provide a conduit for low stream flows. Logs are typically set parallel to the stream channel and brush is piled on top.

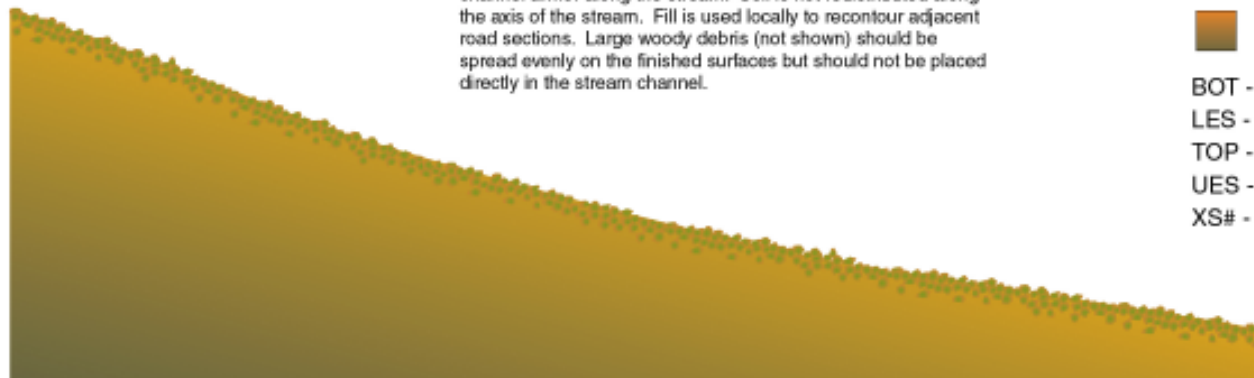


Before treatment

Following placement of logs and debris in the channel, fill is pushed from adjacent road sections onto the woody debris, filling the inner gorge to cross the stream. A defined channel is present upstream and downstream of the crossing. An alluvial wedge is often impounded upstream of the crossing. Diversions at these crossings are common and pose serious erosion threats.

After treatment

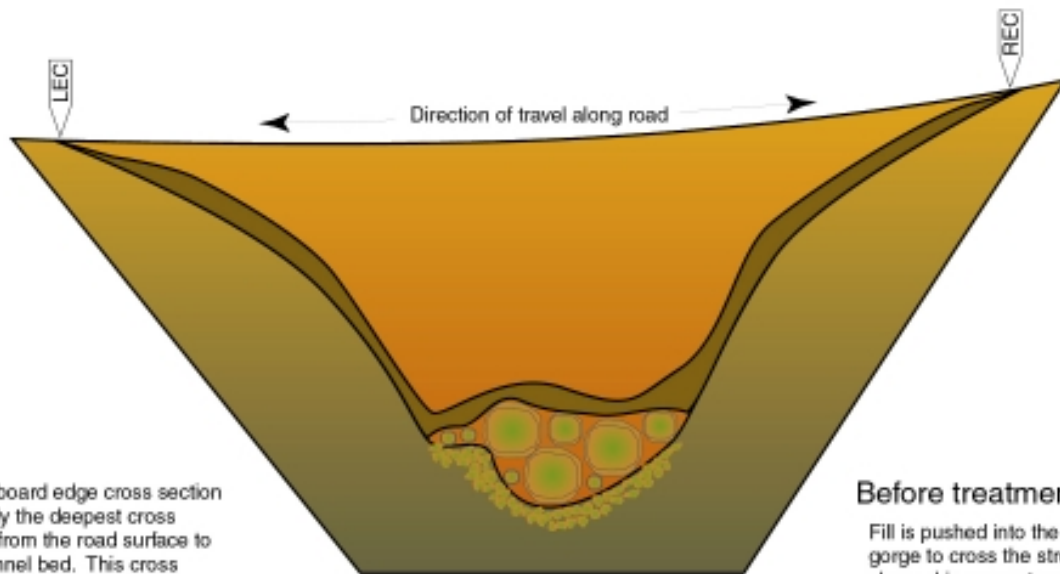
Fill and logs are excavated from the channel to re-expose the channel armor along the stream. Soil is not redistributed along the axis of the stream. Fill is used locally to recontour adjacent road sections. Large woody debris (not shown) should be spread evenly on the finished surfaces but should not be placed directly in the stream channel.



LEGEND

- Bedrock
- Excavated Fill
- BOT - Bottom of cut
- LES - Lower end stake
- TOP - Top of cut
- UES - Upper end stake
- XS# - Cross section

Humboldt Stream Crossing Excavation Cross Section Cutaway



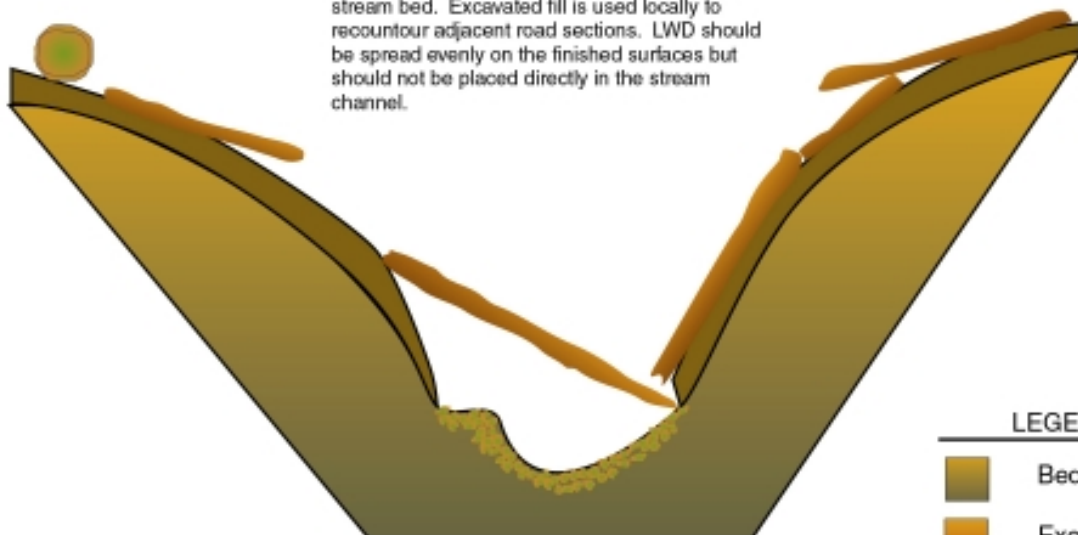
The outboard edge cross section is usually the deepest cross section from the road surface to the channel bed. This cross section would be representative of an outboard edge cross section. This view is looking downstream.

Before treatment

Fill is pushed into the channel and inner gorge to cross the stream channel. A channel is present upstream and downstream of the crossing. Logs and/or culverts are common in these crossings to convey flow under the road. Diversions at these crossings are a serious erosion threat.

After treatment

The fill and culverts are excavated from the channel to re-expose the channel armor along the stream. Soil is not redistributed along the stream bed. Excavated fill is used locally to recountour adjacent road sections. LWD should be spread evenly on the finished surfaces but should not be placed directly in the stream channel.



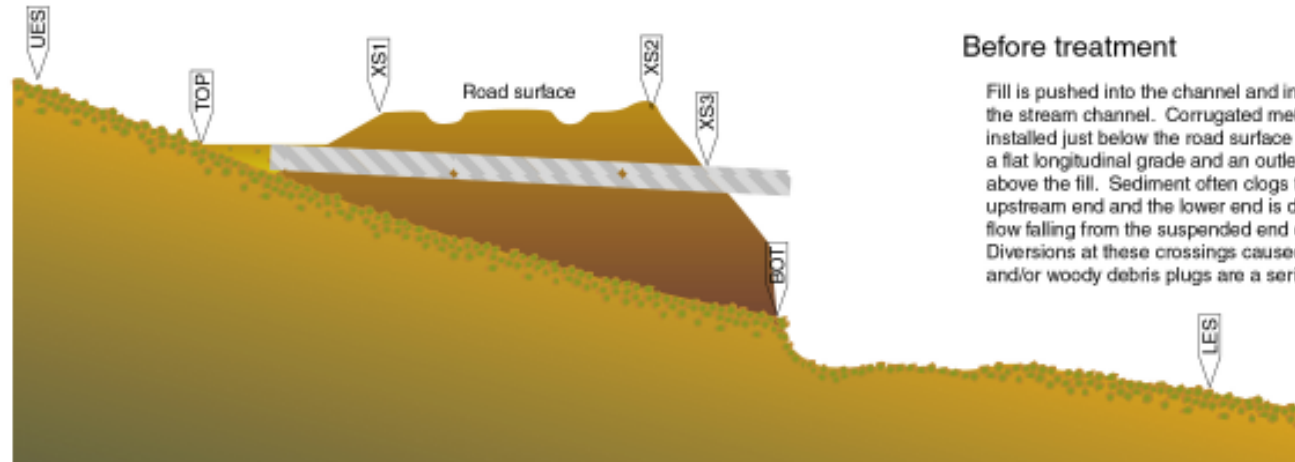
LEGEND

	Bedrock
	Excavated Fill
	Organic soil

LEC - Left edge cut
REC - Right edge cut

Culvert Stream Crossing Excavation Longitudinal Profile Cutaway

The outboard edge cross section (XS2) is usually the deepest cross section from the road surface to the channel.

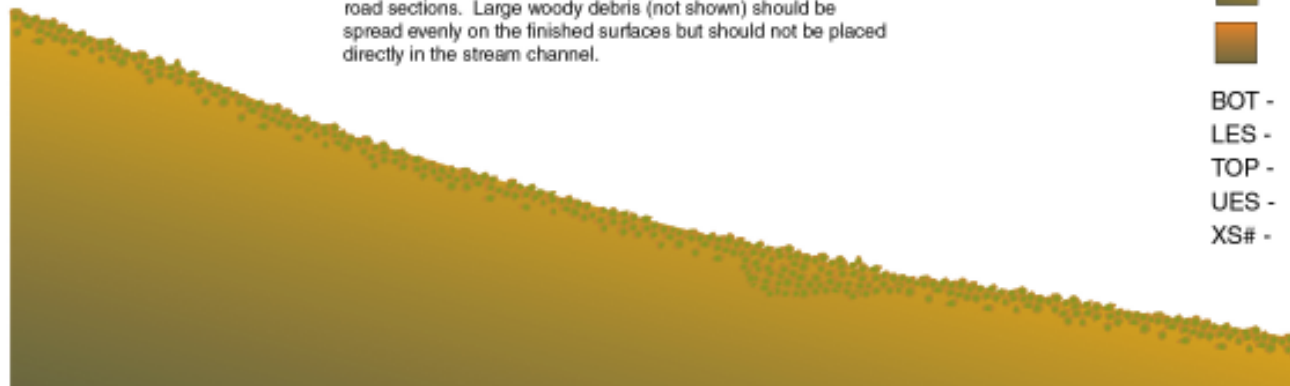


Before treatment

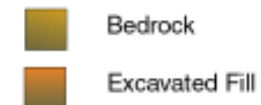
Fill is pushed into the channel and inner gorge to cross the stream channel. Corrugated metal pipe (CMP) installed just below the road surface is typically set with a flat longitudinal grade and an outlet hanging well above the fill. Sediment often clogs the pipe at the upstream end and the lower end is deeply scoured by flow falling from the suspended end of the culvert. Diversions at these crossings caused by sediment and/or woody debris plugs are a serious erosion threats.

After treatment

Fill and culverts are excavated from the channel to re-expose the channel armor along the stream. Soil is not redistributed along the axis of the stream. Fill is used locally to recontour adjacent road sections. Large woody debris (not shown) should be spread evenly on the finished surfaces but should not be placed directly in the stream channel.



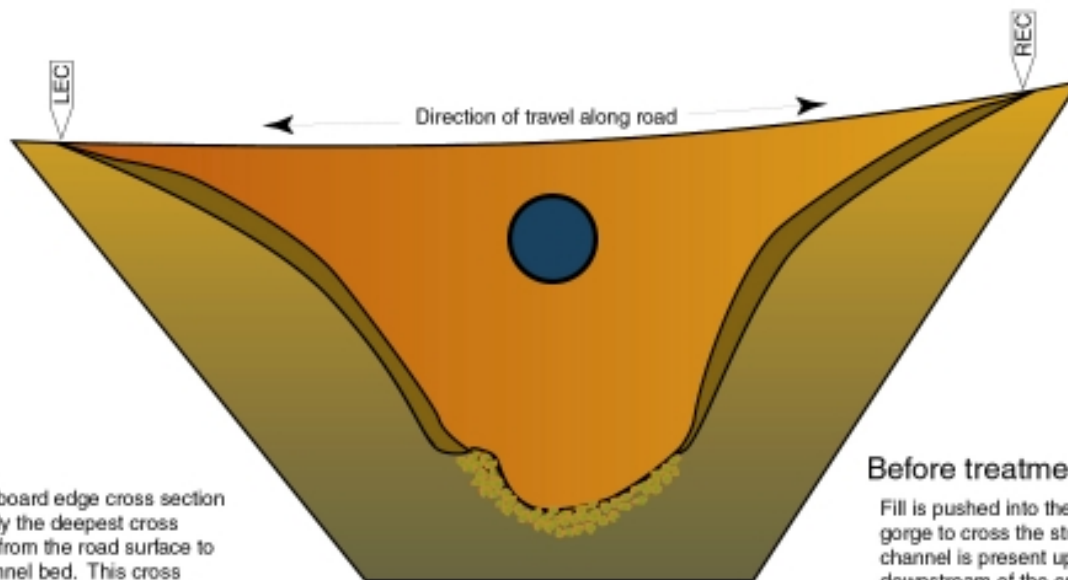
LEGEND



BOT - Bottom of cut
LES - Lower end stake
TOP - Top of cut
UES - Upper end stake
XS# - Cross section

Culvert Stream Crossing Excavation

Cross Section Cutaway



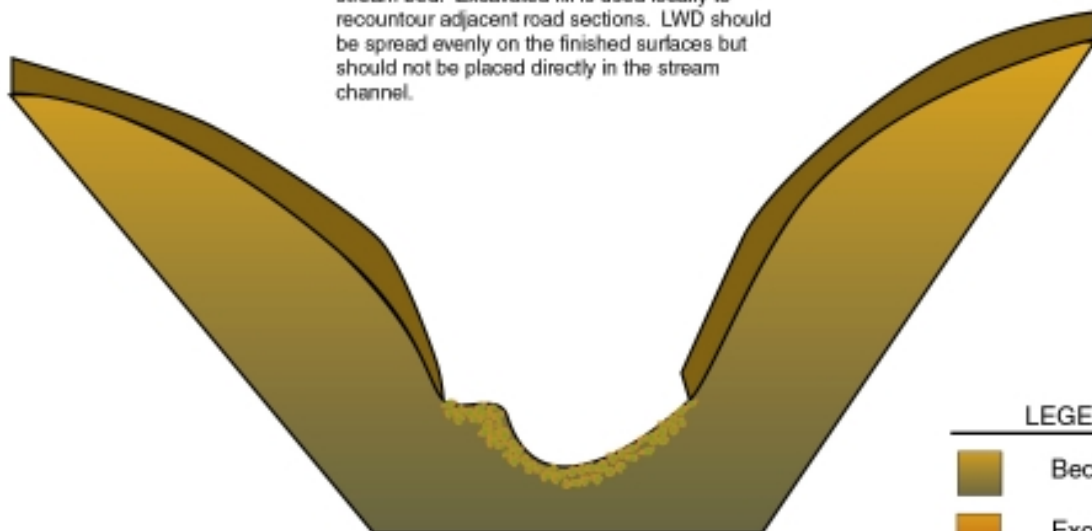
The outboard edge cross section is usually the deepest cross section from the road surface to the channel bed. This cross section would be representative of an outboard edge cross section. This view is looking downstream.

Before treatment

Fill is pushed into the channel and inner gorge to cross the stream channel. A channel is present upstream and downstream of the crossing. Culverts are common in these crossings to convey flow under the road. Usually culverts are set too high and undercut the outboard fill as water "shotguns" from the outlet. Diversions at these crossings are a serious erosion threat.

After treatment

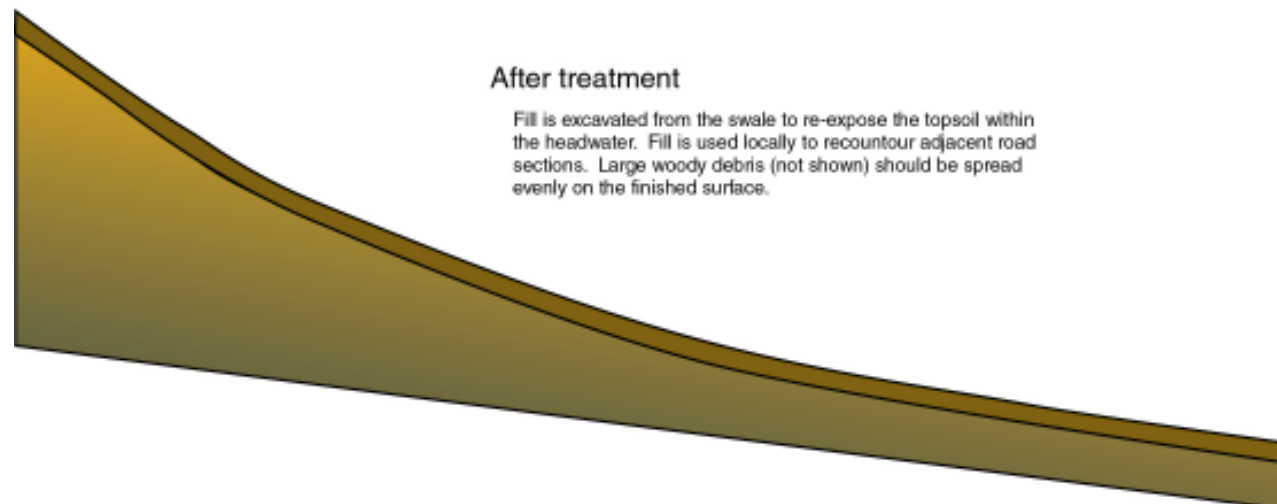
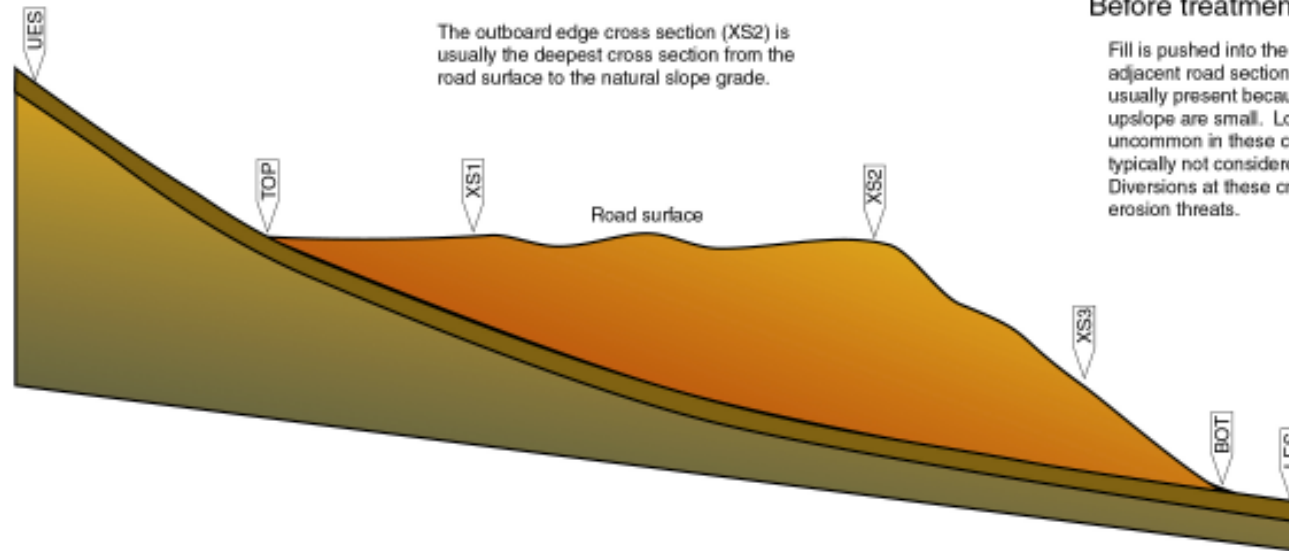
The fill and culverts are excavated from the channel to re-expose the channel armor along the stream. Soil is not redistributed along the stream bed. Excavated fill is used locally to recountour adjacent road sections. LWD should be spread evenly on the finished surfaces but should not be placed directly in the stream channel.



LEGEND

- Bedrock
- Excavated Fill
- Organic soil
- LEC - Left edge cut
- REC - Right edge cut

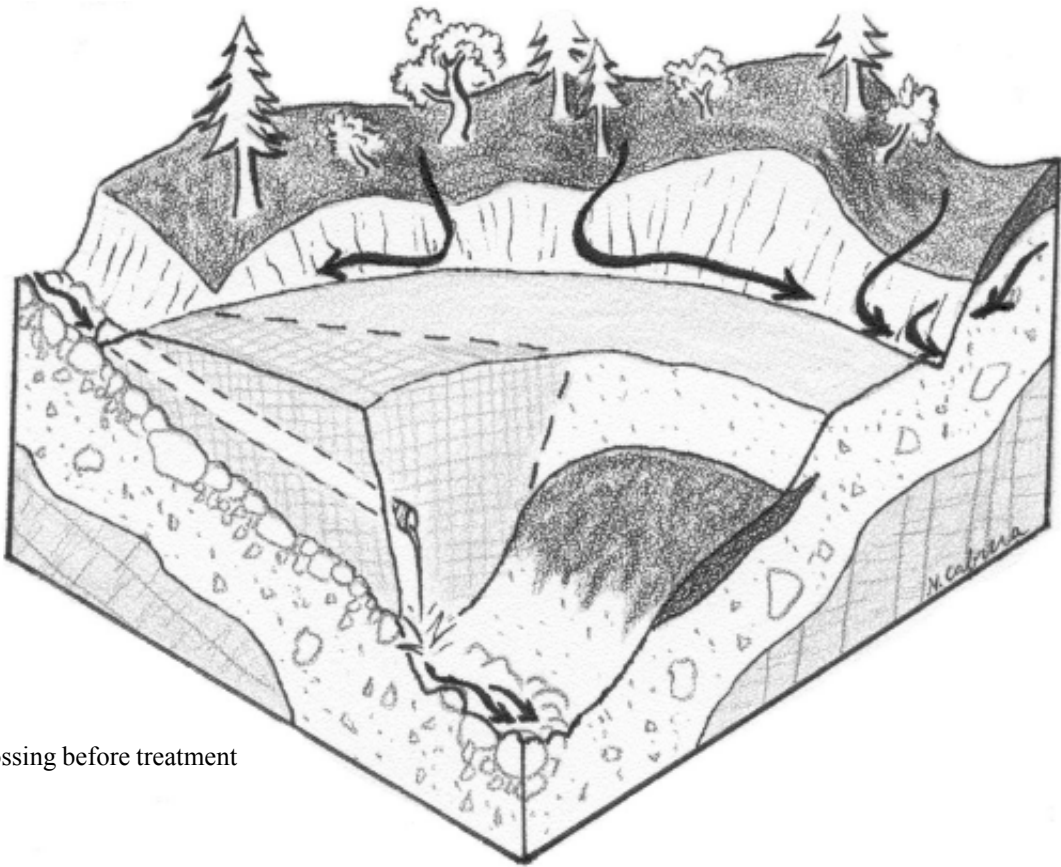
Headwater Swale Export Recontour Cross Section Cutaway



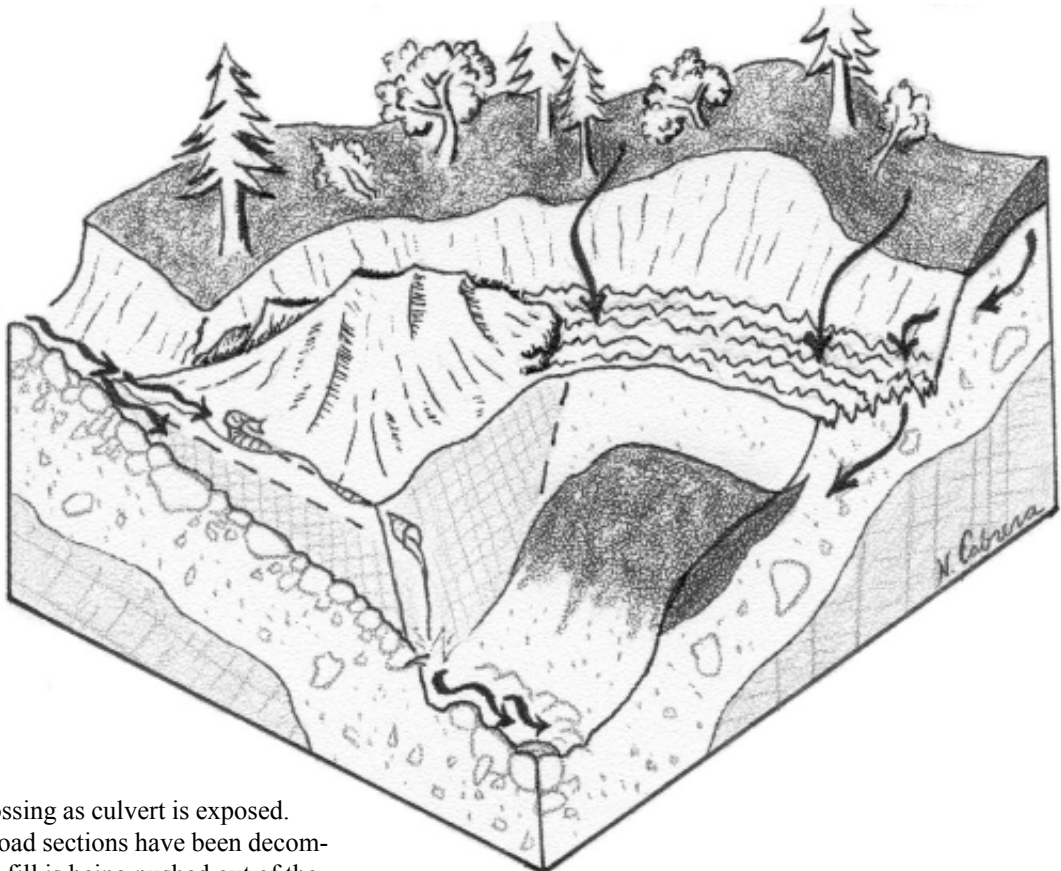
LEGEND

- Bedrock
- Excavated Fill

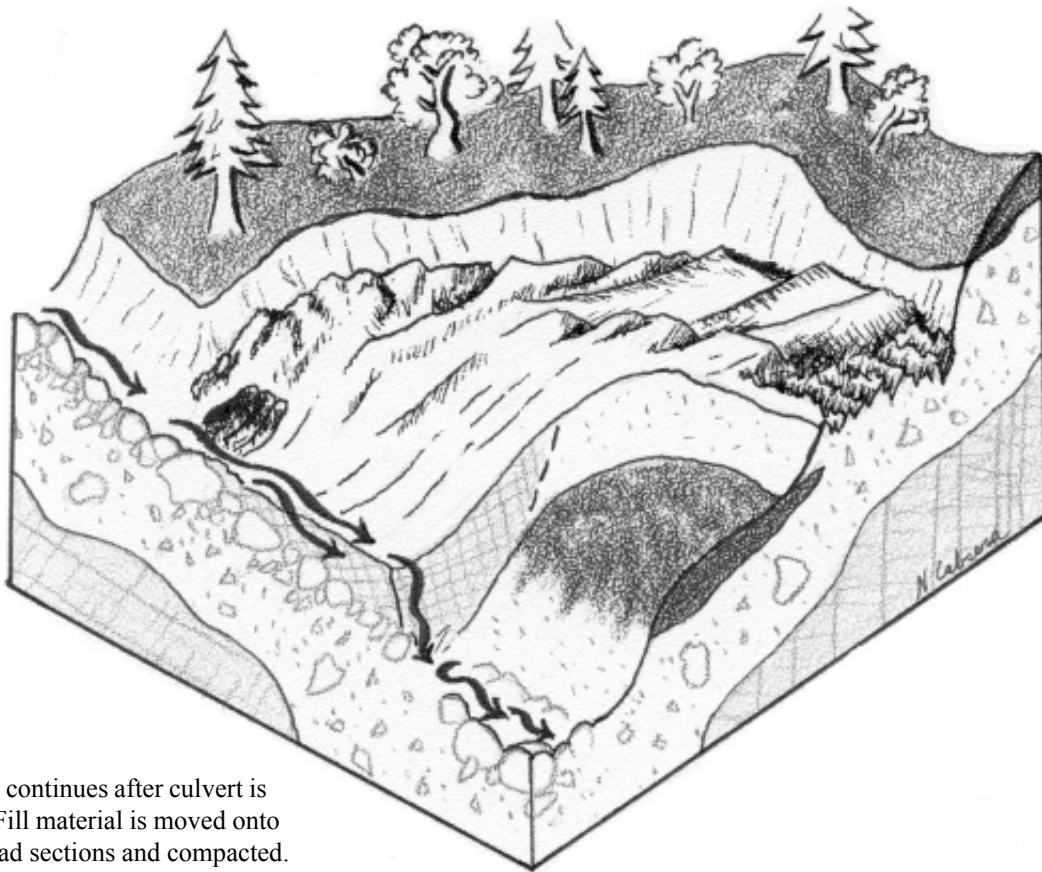
- BOT - Bottom of cut
- LES - Lower end stake
- TOP - Top of cut
- UES - Upper end stake
- XS# - Cross section



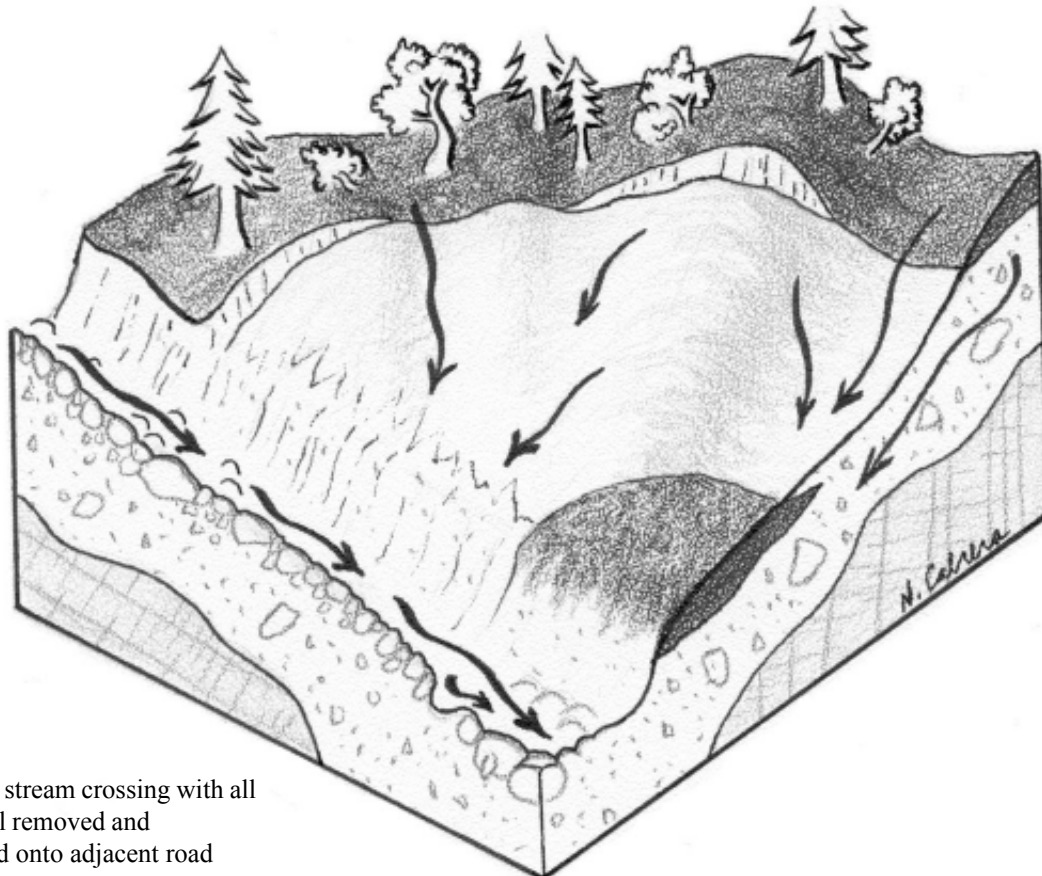
Stream crossing before treatment



Stream crossing as culvert is exposed.
Adjacent road sections have been decompacted and fill is being pushed out of the crossing.



Excavation continues after culvert is removed. Fill material is moved onto adjacent road sections and compacted.



Completed stream crossing with all fill material removed and recontoured onto adjacent road sections.