EPA Region 10 Source Water Protection
Best Management Practices for USFS, BLM

Introduction

The following pages include a listing of best management practices (BMPs). Some are required by USDA Forest Service and Bureau of Land Management (BLM) management plans or by State administrative code. Others are recommendations or are informed by a legal decision. This list represents an initial effort to pull together BMPs from a host of sources to assist in protection of drinking water sources. BMPs in the first two sections, "Conservative Riparian Reserve Widths" and "Watershed Management Planning," pertain generally to all actions undertaken by the USFS or BLM. The other sections pertain to more specific types of activities, facilities, or structures on USFS or BLM lands, such as roads, recreational facilities, underground storage tanks, and fire suppression activities.

Context and Background

The USDA Forest Service and BLM have a long history of using BMPs related to timber harvest, grazing, mining, and other land management activities to reduce adverse impacts to water quality. Forest and range land management activities generate diffuse sources of pollution known as nonpoint sources. Assessments of water quality completed at the national level and at the watershed scale have consistently demonstrated that nonpoint sources of pollution (agriculture, mining, construction, forestry, etc.) are the primary cause of water quality impairment. Point sources of pollution, like wastewater treatment facilities and factories, are required to treat effluent to meet water quality standards consistent with State or Federally issued discharge permits. Nonpoint sources require a different approach. BMPs are the primary management mechanism for preventing or reducing impacts to water quality from nonpoint sources. Many States have designated the Forest Service and BLM as the management agencies for implementing BMPs on lands they manage to ensure that water quality standards are met.

Forest Service and BLM lands, usually located in the upper portion of a watershed, capture a significant portion of the precipitation that ends up as drinking water for millions of people in the Pacific Northwest. The Safe Drinking Water Act required states to delineate source water areas for every public drinking water system and assess risks of potential contamination within those areas. Infrastructure and activities of the Forest Service and BLM are included among many identified potential sources of contamination to drinking water supplies. Careful planning and implementation can mitigate the risks of contamination from Forest Service and BLM operations and activities.

The effectiveness of BMPs applied on federal lands affects the quality of water entering drinking water wells and intakes on both federal lands and downstream non-federal lands. Providing the highest quality water possible to the drinking water intakes should be an overriding goal of BMPs. BMPs cover a full spectrum of active and passive measures and can be applied during assessment, planning, project implementation, and monitoring activities. The following BMPs

are an initial "draft" starting point for helping to ensure that public health is protected and that water treatment and facility operation and management costs are minimized.

Best Management Practices

Conservative Riparian Reserve Widths

Northwest Forest Plan

Fish-bearing streams – Riparian Reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest.

Permanently flowing nonfish-bearing streams – Riparian Reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.

Constructed ponds and reservoirs, and wetlands greater than 1 acre – Riparian reserves consist of the body of water or wetland and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.

Lakes and natural ponds – Riparian Reserves consist of the body of water and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.

Seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas – This category applies to features with high variability in size and site-specific characteristics. At a minimum, the Riparian Reserves must include:

- The extent of unstable and potentially unstable areas (including earthflows)
- The stream channel and extend to the top of the inner gorge
- The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, and
- Extension from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest.

A site-potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site class.

Intermittent streams are defined as any nonpermanent flowing drainage feature having a

definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria.
Source: Aquatic Conservation Strategy, Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within Range of the Northern Spotted Owl, pp. C-30-31.

PACFISH (INFISH contains similar provisions)

Category 1- Fish-bearing streams: Interim Riparian Habitat Conservation Areas (RHCAs) consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest.

Category 2- Permanently flowing nonfish-bearing streams: Interim RHCAs consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.

Category 3- Ponds, lakes, reservoirs and wetlands greater than one acre: Interim RHCAs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of moderately and highly unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the maximum pool elevation of constructed ponds and reservoirs or from the edge of the wetland, pond or lake, whichever is greatest.

Category 4- Seasonally flowing or intermittent streams, wetlands less than 1 acre, landslides, and landslide prone areas: This category applies to features with high variability in size and site-specific characteristics. At a minimum, the RHCAs must include:

a. the extent of landslides and landslide prone areas
b. the intermittent stream channel and the area to the top of the inner gorge
c. the intermittent stream channel or wetland and the area to the outer edges of the riparian vegetation.
d. for Key Watersheds, the area from the edges of the stream channel, wetland, landslide, or landslide prone area to a distance equal to a height of one site-potential tree, or 100 feet slope distance, whichever is greatest.
e. For watersheds not identified as Key Watersheds, the area from the edges of the stream channel, wetland, landslide, or landslide prone area to a distance equal to a height of one-half site potential tree, or 50 feet slope distance, whichever is greatest.

In non-forested rangeland ecosystems, the interim RHCA width for permanently flowing streams in categories 1 and 2 is the extent of the 100-year flood plain.
Source: Decision Record for the Interim Strategies for Managing Anadromous fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California, pp. C-8, C-9.

Watershed Management Planning

Employ Watershed Restoration Projects where appropriate to repair degraded watershed conditions and improve water quality and soil stability. (p. 49)

Avoid, where possible, the long- and short-term adverse impacts to water quality associated with the occupancy and modification of floodplains. (p. 50)

Avoid destruction of wetlands. (p. 51)

Prevent contamination from accidental spills.

- An Oil and Hazardous Substance Spill Contingency Plan is a predetermined organization and action plan to be implemented in the event of a hazardous substance spill.
- A Spill Prevention Control and Countermeasures (SPCC) Plan is required if the total amount of oil products on site in above-ground storage exceeds 1320 gallons, or if a single container exceeds a capacity of 660 gallons. (p. 51)

Protect the beneficial uses of water and streams from the cumulative effects of multiple land management activities which may result in adverse (degraded) water quality or stream habitat conditions. (p. 52)

Ensure activities conducted under Special Use Permits are protective of source waters. (p. 53)

Conduct water quality monitoring to determine the effects of land management activities on the beneficial uses of water, and to ensure the health and safety of water users. (p. 54)

Exclude activities that could result in damage to either resources or improvements, such as roads and trails, resulting in impaired water quality.

Minimize the amount of erosion and sedimentation at developed sites. (p. 55)
Source: General Water Quality Best Management Practices, Pacific Northwest Region, November 1988

Avoid any activity within 200 yards of a drinking water intake on surface water.

Take active measures, if necessary, to avoid any activity within 200 yards of a spring used as a source of drinking water.
Source: EPA Region 10 recommendations

Hardrock Mining

Concern for: Surface Water, Ground Water

Contaminants: Metals (e.g., lead, selenium, cadmium, copper, zinc, arsenic, mercury), acidity (low pH), cyanide, sulfate, turbidity

Both the US Forest Service and Bureau of Land Management have extensive internal guidance on mine permitting and reclamation requirements.

Two documents available on the EPA Region 10 website provide detailed information that should be reviewed when addressing mining issues:

> *EPA and Hardrock Mining: A Source Book for Industry in the Northwest and Alaska*, U.S. EPA Region 10, January 2003
> http://yosemite.epa.gov/r10/water.nsf/59f3b8c4fc8c923988256b580060f5d9/e4ba15715e97ef2188256d2c00783a8e!OpenDocument
>
> *Inactive Mine Site Characterization and Cleanup Handbook*, EPA 910-8-00-001, U.S. EPA, August 2000
> http://yosemite.epa.gov/R10/CLEANUP.NSF/9f3c21896330b4898825687b007a0f33/f4724f10ccdc2f4d8825699a007861dd?OpenDocument

Forests and BLM Districts in Idaho should consult,

> *Best Management Practices for Mining in Idaho*, prepared by The Idaho Department of Lands in conjunction with other State and Federal Agencies through the Idaho Mining Advisory Committee, 1992.

Best Management Practices:

Require a reclamation plan, approved Plan of Operations, and reclamation bond for all minerals operations that include Riparian Reserves. Such plans and bonds must address the costs of removing facilities, equipment, and materials; recontouring disturbed areas to near pre-mining topography; isolating and neutralizing or removing toxic or potentially toxic materials; salvage and replacement of topsoil; and seedbed preparation and revegetation to meet Aquatic Conservation Strategy objectives.

Locate structures, support facilities, and roads outside Riparian Reserves. Where no alternative to siting facilities in Riparian Reserves exists, locate them in a way compatible with Aquatic Conservation Strategy objectives. Road construction will be kept to the minimum necessary for the approved mineral activity. Such roads will be constructed and maintained to meet roads management standards and to minimize damage to resources in the Riparian Reserve. When a road is no longer required for mineral or land management activities, it will be closed, obliterated, and stabilized.

Prohibit solid and sanitary waste facilities in Riparian Reserves. If no alternative to locating mine waste (waste rock, spent ore, or tailings) facilities in Riparian Reserves exists, and releases can be prevented, and stability can be ensured, then:

a. analyze the waste material using the best conventional sampling methods and analytic techniques to determine its chemical and physical stability characteristics.
b. locate and design the waste facilities using best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials. If the best conventional technology is not sufficient to prevent such releases and ensure stability

over the long term, prohibit such facilities in Riparian Reserves.

c. Monitor waste and waste facilities after operations to ensure chemical and physical stability and to meet Aquatic Conservation Strategy objectives.
d. Reclaim waste facilities after operations to ensure chemical and physical stability and to meet Aquatic Conservation Strategy objectives.
e. Require reclamation bonds adequate to ensure long-term chemical and physical stability of mine waste facilities.

Salable mineral activities such as sand and gravel mining and extraction within Riparian Reserves will occur only if Aquatic Conservation Strategy objectives can be met.

Include inspection and monitoring requirements in mineral plans, leases or permits. Evaluate the results of inspection and monitoring to effect the modification of mineral plans, leases and permits as needed to eliminate impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.

Source: Aquatic Conservation Strategy, Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within Range of the Northern Spotted Owl, pp. C-34-35.

Avoid siting mines in Wellhead Protection Areas and the riparian zones of surface Source Water Areas if possible.

Inventory abandoned and active mines in Source Water Areas. In surface Source Water Areas conduct upstream and downstream monitoring to determine if the mines are degrading water quality. In Wellhead Protection Areas, install monitoring wells to determine if ground water quality is degraded. If degradation has occurred, identify sources and implement appropriate mitigation actions.

If ground water or surface water contamination is possible, reclamation plans need to include contingency actions for long-term water treatment. Costs of treatment must be bonded.

EPA Region 10 recommendations

Oil and Gas

For leasable minerals, prohibit surface occupancy within Riparian Reserves for oil, gas, and geothermal exploration and development activities where leases do not already exist. Where possible, adjust the operating plans of existing contracts to eliminate impacts that retard or prevent the attainment of Aquatic Conservation Strategy objectives.

Source: Aquatic Conservation Strategy, Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within Range of the Northern Spotted Owl, pp. C-34-35.

Grazing

Concern for: Surface Water

Contaminants: Pathogens (E. Coli, cryptosporidium, viruses, giardia lambia), sediment, turbidity, phosphate, nitrates, coliform, sulfate.

Sources: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 153-156. Potential Sources of Drinking Water Contamination Index, EPA. www.epa.gov/safewater/swp/sources1.html

Best Management Practices:

Manage the timing and intensity of grazing to:

- ∃ enhance, or at a minimum, prevent the degradation of, riparian vegetation
- ∃ enhance infiltration of surface water into the ground
- ∃ ensure stream banks are protected

Within source water protection areas, sheep grazing is preferable over cattle because sheep tend to graze in upland areas while cattle tend to spend time in the streams.

The exclusion of cattle from areas where cryptosporidium may be a concern (such as Source Water Areas) should be considered. If this is not feasible, livestock younger than 4 months should be kept out of the watershed, because calves have not yet developed resistance, and shed greater numbers of oocysts than older animals.

Source: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 153-156

Locate new livestock handling and/or management facilities outside Riparian Reserves. For existing livestock handling facilities inside the Riparian Reserve, ensure that Aquatic Conservation Strategy objectives are met. Where these objectives cannot be met, require relocation or removal of such facilities.

Source: Aquatic Conservation Strategy, Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within Range of the Northern Spotted Owl, pp. C-33.

Locate new livestock handling and/or management facilities outside of Riparian Habitat Conservation Areas (RHCA). For existing livestock handling facilities inside the RHCAs, assure that facilities do not prevent attainment of Riparian Management Objectives (RMO) or adversely affect listed anadromous fish. Relocate or close facilities where these objectives cannot be met.

Limit livestock trailing, bedding, watering, salting, loading and other handling efforts to those areas and times that will not retard or prevent attainment of RMOs or adversely affect listed anadromous fish.

Adjust wild horse and burro management to avoid impacts that prevent attainment of RMOs or adversely affect listed anadromous fish.

Source: Decision Record for the Interim Strategies for Managing Anadromous fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California, pp. C-12, C-13.

Manage livestock numbers and season of use to maintain and protect soil and water resources. (p.76)

Construct fences or other barriers to keep livestock out of sensitive areas where loss of vegetative cover, soil compaction, or riparian impairment could adversely impact water quality. (p.77, 78)
Source: General Water Quality Best Management Practices, Pacific Northwest Region, U.S. Forest Service, November 1988

Require grazing permits and allotment management plans to include specific requirements to keep livestock outside of areas that are pathways for giardia, coliforms, and cryptosporidium into drinking water systems.
Source: EPA Region 10 recommendation

Landfills

Concern for: Ground Water, Surface Water

Contaminants: Volatile organic compounds (VOC's), heavy metals, pesticides, nitrates and nitrites, semi-volatile organic compounds.
Source: Potential Sources of Drinking Water Contamination Index, EPA. www.epa.gov/safewater/swp/sources1.html

Best Management Practices

Site new landfills outside of source water protection areas if possible. If not possible, site them where they are unlikely to pose a threat to ground water or surface waters.

For historic landfills located in source water protection areas, examine existing data to determine whether they may pose a threat to the drinking water source. If a landfill may pose a threat, collect additional data to determine whether it does. If it does, plan and implement appropriate mitigative action.
Source: EPA Region 10 recommendations

Recreation Sites

Concern for: Ground Water, Surface Water
Contaminants: Turbidity, sedimentation, fecal material, household cleansers and detergents, garbage and other floatables, cooking grease and oil, antifreeze, motor oil, illegal dumping of hazardous materials

Best Management Practices
Wastewater from sanitation facilities can contaminate surface and ground water with bacteria, nutrients, and chemicals. Sanitation facilities (ranging from pit toilets to treatment plants) will be planned, located, designed, constructed, operated, inspected, and maintained to minimize possibilities of water contamination. All activities related to location, design, inspection, operation, and maintenance will be performed by trained, qualified personnel. (p. 64)

Refuse disposal will be managed to protect surface and subsurface soil and water resources from contamination by nutrients, bacteria, and chemicals. Public education encourages users of the National Forests to use proper disposal procedures. (p. 65)

Manage off-road vehicle use to eliminate adverse effects to water quality. (p.67)

Prohibit discharges and disposal of human and animal waste, petroleum products, and other hazardous substances in or near streams in recreation areas. Educate the public to conduct their activities in ways that will not degrade water quality. (p. 68)

Avoid degradation of water quality by locating pack and riding stock facilities at safe locations away from springs, streams, lakes, wet meadows, and other surface waters. (p. 69)
Source: General Water Quality Best Management Practices, Pacific Northwest Region, U.S. Forest Service, November 1988.

RV sewage waste should not be disposed of in septic system drainfields given the potential for chemicals in the sewage waste to kill the microorganisms that drainfields need to function.
EPA Region 10 Recommendation

Timber Management

Concern for: Surface Water
Contaminants: Turbidity, decreased dissolved oxygen, pathogens, nitrogen

Best Management Practices

Plan, supervise, and implement forest projects that will minimize soil compaction and soil disturbance.

Keep the cut small and hydrologically isolated.

Maintain as much ground cover as possible to reduce surface runoff and erosion.

Use filter strips to trap erosion, as appropriate.

Operate during the season with the lowest erosion risk.

Minimize site disturbance.

Re-establish vegetation as soon as practicable.

Keep pesticides and fertilizers out of surface waters.
Source: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 108-113

Prohibit timber harvest, including fuelwood cutting, in Riparian Reserves, [except as allowed on page C-32 of the Aquatic Conservation Strategy.]
Source: Aquatic Conservation Strategy, Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within Range of the Northern Spotted Owl, p. C-32.

Prohibit timber harvest, including fuelwood cutting, in Riparian Habitat Conservation Areas (RHCA), except as described below. Do not include RHCAs in the land base used to determine

the Allowable Sale Quantity, but any volume harvested can contribute to the timber sale program.

a. Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting in RHCAs only where present and future woody debris needs are met, where cutting would not retard or prevent attainment of other Riparian Management Objectives (RMO), and where adverse effects on listed anadromous fish can be avoided. For watersheds with listed salmon or designated critical habitat, complete Watershed Analysis prior to salvage cutting in RHCAs.
b. Apply silvicultural practices for RHCAs to acquire desired vegetation characteristics where needed to attain RMOs. Apply silvicultural practices in a manner that does not retard attainment of RMOs and that avoids adverse effects on listed anadromous fish.

Source: Decision Record for the Interim Strategies for Managing Anadromous fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California, p. C-10

Ensure that timber harvest unit design will secure favorable conditions of water flow, water quality, and fish habitat. (p. 10)

Prevent downstream water quality degradation by the timely identification of areas with high erosion potential and adjustment of harvest unit design. (p. 11)

Delineate the location of protection areas and available water sources as a guide for both the Purchaser and the Sale Administrator, and to ensure their recognition and proper consideration and protection on the ground. (p. 11)

Ensure that the Purchaser conducts operations in a timely manner, within the time period specified in the Timber Sale Contract (TSC). The TSC specifies a Normal Operating Season, during which operations may generally proceed without resource damage. (p. 12)

Provide for identification and appropriate management prescriptions for unstable lands. (p. 12)

Designate a riparian area or zone along streams and wetlands where prescriptions are made that will minimize potential adverse effects of nearby login and related land disturbance activities on water quality and beneficial uses. (p. 13)

Protect the natural flow of streams, provide unobstructed passage of stormflows, and prevent sediment and other pollutants from entering streams. (p. 14)

Protect water quality from degradation cause by tractor logging ground disturbance. (p. 15)

Locate landings in such a way as to minimize creation of hazardous watershed conditions. (p. 15)

Locate and design Tractor Skid Trails to minimize the area compacted, erosion, and runoff water. (p. 16)

If Suspended Log Yarding is employed, protect soils from excessive disturbance, and maintain

the integrity of the Stream Management Unit and other sensitive watershed areas. (p. 16)

Ensure that the Purchaser's operations shall be conducted to minimize soil erosion. (p. 17)

Use mitigative measures to reduce the impacts of erosion, and subsequent sedimentation, on log landings. (p. 18)

Ensure that constructed erosion control structures are stabilized and working. (p. 19)

Reforest all suitable land harvested within five years after the regeneration cut and promptly reforest all other suitable areas not harvested but in need of reforestation. (p. 20)

Prevent pollutants such as fuels, lubricants, bitumen's, raw sewage, wash water and other harmful materials from being discharged into or near rivers, streams, and impoundments or into natural or man-made channels leading thereto. (p. 21)
Source: General Water Quality Best Management Practices, Pacific Northwest Region, U.S. Forest Service, November 1988.

Fire Management

Concern for: Surface Water
Contaminants: Sediment and turbidity, nitrates, nitrites, sulfate, pH, TDS, chloride, iron, phosphate, taste/color/smell
USGS Emerging Contaminant: fire retardant

Best Management Practices

Avoid spraying fire repellant in or near drinking water streams, if practicable.

Utilize Burn Area Emergency Rehabilitation (BAER) in appropriate circumstances.

For prescribed fires:
- ∃ Plan to preserve appropriate stream buffers to minimize erosion.
- ∃ Avoid prescribed burns on steep slopes
- ∃ Limit fire severity
- ∃ Limit burning on sandy or potentially water-repellant soils

Source: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 135

Design fuel treatment and fire suppression strategies, practices, and activities to meet Aquatic Conservation Strategy objectives, and to minimize disturbance of riparian ground cover and vegetation.

Locate incident bases, camps, helibases, staging areas, helispots and other centers for incident activities outside Riparian Reserves. If the only suitable location for such activities is within the Riparian Reserve, an exemption may be granted following review and recommendation by a resource advisor. The advisor will prescribe the location, use conditions, and rehabilitation

requirements. Use an interdisciplinary team to predetermine suitable incident base and helibase locations.

Minimize delivery of chemical retardant, foam, or additives to surface waters. An exception may be warranted in situations where overriding immediate safety imperatives exist, or, following review and recommendation by a resource advisor, when an escape would cause more long term damage.
Source: Aquatic Conservation Strategy, Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within Range of the Northern Spotted Owl, pp. C-35-36.

During fire suppression efforts, avoid watershed damage in excess of that which would be caused by the fire itself. Avoid heavy equipment operation on fragile soils and steep slopes when possible. Project fires should use a Resource Advisor and watershed specialists to advise the Incident Commander on resource values during the suppression effort. (p. 46)

Stabilize all areas that have had their erosion potential significantly increased, or their drainage pattern altered by wildfires or by suppression related activities. Treatments include, but are not limited to:

- installing water bars and other drainage diversions in fire roads, firelines, and other cleared areas;
- seeding, planting and fertilizing to provide vegetative cover;
- spreading slash or mulch to protect bare soil;
- repairing damaged road drainage facilities;
- clearing stream channels of structures or debris that is deposited by suppression activities;
- log erosion barriers (contour-felled and anchored trees)
- channel stabilization structures
- trash racks above road drainage structures
- debris retention structures (p. 46/47)

Provide for water quality protection in formulating prescribed fire prescriptions. Prescription elements include fire weather, slope, aspect, soil moisture, and fuel moisture. These elements influence the fire intensity and thus have a direct effect of whether or not a desired ground cover remains after burning, and whether or not a water repellent layer is formed. The amount of remaining ground cover and extensiveness of water repellant soil can significantly affect erosion rates. (p. 45)

Maintain soil productivity, minimize erosion, and prevent ash, sediment, nutrients, and debris from entering water bodies during prescribed fires. Some of the techniques used to prevent water quality degradation include:

- maintaining the integrity of the Stream Management Unit or streamcourse
- planning prescribed fires with intensities that will not result in soils becoming hydrophobic

Source: General Water Quality Best Management Practices, Pacific Northwest Region, U.S. Forest Service, November 1988.

Road Building and Maintenance

Concern for: Ground Water, Surface Water

Contaminants: sediment, metals, hydrocarbons, phosphates, pesticides, other chemicals.

Source: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 85-100.

Best Management Practices:

Apply high quality gravel to unpaved roads to reduce erosion.
Decrease spacing of cross drainages.
Locate roads further from streams.
Limit road gradients.
Install sediment basins below culverts.
Remove unwanted roads and culverts.
Coordinate spill response plans with local and state governments.

Source: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 85-100.

For each existing or planned road:

a. minimize road landing locations in Riparian Reserves.
b. complete watershed analysis (including appropriate geotechnical analyses prior to construction of new roads or landings in Riparian Reserves.
c. Prepare road design criteria, elements, and standards that govern construction and reconstruction.
d. Prepare operation and maintenance criteria, elements, and standards that govern construction and reconstruction.
e. Minimize disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow.
f. Restrict sidecasting as necessary to prevent the introduction of sediment to streams.
g. Avoid wetlands entirely when constructing new roads.

Minimize sediment delivery to streams from roads. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is unfeasible or unsafe. Route road drainage away from potentially unstable channels, fills, and hillslopes.

Source: Aquatic Conservation Strategy, Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within Range of the Northern Spotted Owl, pp. C-32.

Road location and design:

1. Do not locate roads in natural drainage channels, sensitive areas, channel migration zones, and riparian management zones, unless there are no other alternatives that would cause less damage to the environment.
2. Minimize the number of stream crossings.
3. When stream crossings are necessary:
    (a) design to minimize alteration to natural features
    (b) locate and design culverts to minimize sediment delivery
    (c) cross streams at right angles to main channel whenever possible.

During construction, manage sediment so that it is deposited in the roadway fill rather than in surface water bodies nearby.

When roadside ditches slope toward surface water bodies, manage runoff so it drains off before reaching the stream.

Design relief culverts for stream-adjacent roads to minimize sediment delivery to the streams.

Road maintenance:

1. Drainage structures should be kept functional.
2. Ground water captured by roads and ditches should be diverted onto stable forest floor.
3. When road surfaces are treated, control runoff of all applied chemicals.

Locate and design roads with minimal resource damage.

- Fragile and special areas that cannot be mitigated to an acceptable level of resource damage should be avoided.
- When possible, roads use non-geometric horizontal and vertical alignment conforming as much as possible to natural ground contours.
- Stream crossing structures shall be designed to provide the most efficient drainage facility consistent with resource protection and costs. (p. 22)

Require and approve an Erosion Control Plan prior to road construction. (p. 23)

Conduct road construction during minimal runoff periods. (p. 24)

Minimize soil erosion from cut slopes, fill slopes, and waste areas through the use of vegetative and/or physical restraint measures to provide for adequate surface soil stability. (p. 26)

Minimize the possibilities of roadbed and cut or fill slope failure and the subsequent production of sediment through appropriate provision of subsurface drainage to avoid saturation of the subgrade. Dispersion methods include: pipe underdrains, horizontal drains, stabilization trenches, drainage blankets or rock drains, ditches. Dispersal of collected water should be accomplished in an area capable of withstanding increased flows. On most soils, energy dissipaters need to be placed at pipe outlets. (p. 27)

Minimize the erosive effects of water concentrated by road drainage features, to disperse runoff from or through the road, and to minimize the sediment generated from the road.

- Ditches, cross drains, water bars, dips, and grade sags are used to take water off the roadbed surface. Methods used to reduce erosion may include such things as energy dissipaters, aprons, downspouts, gabions, debris racks, and armoring ditches and drain inlets and outlets. Soil stabilization can help reduce sedimentation by reducing the effects of erosion on borrow and waste areas, on fill slopes, and on roadbeds.
- Dispersal of runoff from roads can be accomplished by rolling the grade, insloping with cross drains, outsloping, crowning, installation of water spreading ditches, contour trenching, etc.

Dispersal of runoff can reduce peak downstream flows and keep water in its natural drainage area.
- Sediment travel can be reduced by installing measures such as sediment filters, settling ponds, and contour trenches. (p. 28)

Minimize erosion and sedimentation from disturbed ground on projects incomplete at the end of the dry season. Measures include:
- Removal of temporary culverts, culvert plugs, diversion dams or elevated streamcoursing causeways.
- Installation of temporary culverts, side drains, flumes, cross drains, diversion ditches, energy dissipaters, dips, sediment basins, berms, debris racks or other facilities needed to control erosion.
- Removal of debris, obstructions, and spoil material from channels and floodplains.
- Grass seeding, placement of hay bales, and mulching.

Except at designated stream crossings, road fills, waste areas and other embankments must be kept at a distance from nearby streams. (p. 33)

Flow must sometimes be guided or piped around streamside project sites, if deemed necessary by agency due to expected sediment production during construction. Typical examples are bridge and dam construction, or large culvert installation. Ensure that all stream diversions are carefully planned to minimize downstream sedimentation. Restore stream channels to their natural grade, condition and alignment as soon as possible. (p. 34)

Minimize sedimentation and turbidity resulting from excavation for in-channel structures such as bridges and culverts. Protective measures include:
- Excavated material should be kept out of live streams
- Sediment producing material will not be left within reach of anticipated flood flows.
- Downstream sediment basins may be necessary to mitigate impact on low flows.

Properly dispose of road construction debris to ensure it is kept out of streams, prevents subsequent obstruction of channels, and prevents the development of debris dams. (p. 36)

Maintain existing water quality when using surface water for road construction, dust control, and fire control. Water source development should aim toward the construction of durable, long-term water sources, rather than the construction of hasty, expedient developments. Other considerations are:
- Downstream flow should not be reduced so as to detrimentally affect aquatic resources, fish passage, or other uses.
- Small, temporary facilities for gathering water should be constructed of sandbags containing sand, or of other materials and means, which will not introduce sediment in the stream.
- Overflow should go directly back into the stream.
- All temporary facilities for gathering water should be removed prior to periods of seasonal precipitation.
- Road approaches to the water source development should be located to minimize potential

impacts in the riparian zone. These approaches should be gravel surfaced to reduce the effects of spillage from washing sediment into the stream. (p. 38)

Treat road surfaces to prevent loss of materials and sediment production. Road surface treatments include grading, watering, dust oiling, penetration oiling, sealing, aggregate, surfacing, chip-sealing, or paving, depending on traffic, soils, geology, road design standards, the road objectives, and available funding. (p. 39)

Temporary roads are obliterated at the completion of their intended use, generally by:

- Temporary culverts and bridges removed and natural drainage configuration reestablished.
- Road surface deep ripped
- Sideslopes reshaped and stabilized
- Road effectively drained and blocked
- Road returned to resource production through revegetation (grass, browse, or trees) (p. 42)

Source: General Water Quality Best Management Practices, Pacific Northwest Region, U.S. Forest Service, November 1988.

Bio-engineering should be substituted for riprap wherever feasible.
Source: EPA Region 10 Recommendation

Bridges
Concern for: Surface Water

Contaminants: Sediment, metals, hydrocarbons, phosphates, pesticides, other chemicals.

Source: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 85-100.

Best Management Practices:
Limit alterations or disturbance of the stream bed, bank, or bank vegetation; if disturbed, restore these areas.
Source: WAC Chapter 222-24

New culverts, bridges and other stream crossings shall be constructed, and existing culverts, bridges and other stream crossings determined to pose a substantial risk to riparian conditions will be improved, to accommodate at least the 100-year flood, including associated bedload and debris. Priority for upgrading will be based on the potential impact and the ecological value of the riparian resources affected. Crossings will be constructed and maintained to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.
Source: Aquatic Conservation Strategy, Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within Range of the Northern Spotted Owl, pp. C-33.

Road Deicing Salt piles
Concern for: Ground Water, Surface Water
Contaminants: Sodium, Chloride

Best Management Practices:
Design salt piles to prevent runoff or leaching into groundwater.

Proper containment includes: berms and other runoff controls, impermeable liners below pile or other controls to prevent leaching into ground water, top covers, or other controls to prevent wind blowing salt into the air.

Contain runoff using berms and containment structures, such as lined lagoons.

Monitoring: inspect regularly, at least biannually; if depth to groundwater is shallow, or drinking water sources (wells or surface water intakes) are downgradient, should install at least one monitoring well and sample at regular intervals.

Clean up any releases immediately.
Source: New Mexico Environment Department Ground Water Quality Bureau Salt Pile Containment Best Management Practices, May 2001

Other road deicing chemicals
Concern for: Ground Water, Surface Water
Contaminants: Road deicing chemicals

Best Management Practices:
Use alternative deicing chemicals, such as calcium chloride or calcium magnesium acetate in sensitive areas, such as Source Water Areas.

Apply only the amount of deicer needed, and time the application appropriately.
Source: Drinking Water Academy Bulletin, Managing Highway Deicing to Prevent Contamination of Drinking Water, EPA 816-F-02-019, Aug 2002

Rock quarries, gravel pits, borrow pits
Concern for: Ground Water, Surface Water

Contaminants: Various – turbidity, hydrocarbons, phosphates, pesticides, etc. Can serve as a conduit for surface contamination to ground water.

Best Management Practices
Should all be located above the 100-year flood level.

During construction, runoff water should be diverted onto stable forest floor or managed by allowing to pass through settling basins.

When source is exhausted or abandoned, quarries and pits should be reclaimed appropriately, by grading surface slopes to less than angle of repose, reforested, or seeded with ground cover.
Source: WAC Chapter 222-24

Restoration of borrow pits and quarries: Borrow pits and quarries are sometimes susceptible to erosion due to steep sideslopes, lack of vegetation, or their proximity to watercourses. Wherever necessary, prior to removal of rock, top soil should be saved in a stockpile for surface dressing in the post operation rehabilitation period. Once excavation has been completed on all or part of the area, pits can be restored to the requirements of the pit plan. Seeding, mulching, and drainage may be required in accordance with specifications. Sediment basins should be

considered. Access roads to the site shall be treated as required in the plans and specifications. (p. 41)
Source: General Water Quality Best Management Practices, Pacific Northwest Region, U.S. Forest Service, November 1988, p. 41.

Pesticides
Concern for: Ground Water, Surface Water
Contaminants: Organic and inorganic chemicals

Best Management Practices

An applicator who applies a pesticide as part of a forestry vegetation management project may not apply a pesticide within a protective area of 200 feet, measured horizontally, from a surface water source that is used for a public water system.
Source: Alaska Pesticide Regulations, 18 AAC 90, Pesticide Control , Article 8, Forestry Vegetation Management, Section 800 Protective Area

Avoid aerial pesticide spraying within 100 yards of surface water (ordinary high water mark). Avoid ground application of pesticides within 20 yards of surface water.
Source: Based on interim buffers prescribed in an Order signed by Honorable John C. Coughenour, United States District Court, Western District of Washington at Seattle, Case Number C01-0132C - Washington Toxics Coalition, Northwest Coalition for Alternatives to Pesticides, Pacific Coast Federation of Fishermen's Associations, and Institute for Fisheries Resources, Plaintiffs, vs. Environmental Protection Agency, and Mike Leavitt, Administrator, Defendants, vs. American Crop Protection Association et al, Intervenors-Defendants

Only use U.S. EPA registered pesticides and comply with all label directions for use.

Ensure proper transportation, handling and application according to the label.

Do not apply during or right before significant weather events, such as heavy rainfall, which will cause runoff of pesticides.

Store pesticides according to label directions so that spills and loss are prevented.

Mix and load pesticides on impermeable surfaces where any accidental spills would not enter surface waters or potentially impact drinking water supplies.

Contain and clean up spills immediately; report spills to appropriate regulatory agency.

Dispose of containers properly; recycle if possible.
Sources: Drinking Water Academy, Managing Large-Scale Application of Pesticides to Prevent Contamination of Drinking Water, EPA-916-F-01-030, July 2001, and WAC Chapter 222-38

Notify downstream water systems so the appropriate operational changes can be made prior to spraying to utilize appropriate filtration or switch to ground water sources.

Consider alternatives to pesticide and herbicide use including biological controls, prescribed fire, mechanical treatments, and silvicultural management systems which minimize or eliminate the need for chemical use (un-even aged management, single and group tree selection, etc.).
Source: EPA Region 10 recommendations

Fertilizers
Concern for: Ground Water, Surface Water
Contaminants: Nitrogen and phosphorous, other nutrients

Best Management Practices
1. Apply fertilizers at appropriate agronomic rates so that no ground water pollution will occur below the root zone.
2. Do not apply fertilizer during or right before significant weather events, such as heavy rainfall, which will cause runoff of pesticides
3. Storage and loading areas should be located where accidental spills will not enter surface waters and should not be located near wellheads.
4. Follow label directions for storage, mixing, and disposal
5. Apply fertilizers by hand in watersheds with drinking water intakes. Numerous buffer distances are presented in WAC Chapter 222-38 for different water types.
6. Prevent fertilizers from entering streams with drinking water intakes.
7. Contain and clean up all spills immediately; report to appropriate regulatory agency

Source: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 113-115, WAC Chapter 222-38

Forest Chemicals (including pesticides and fertilizers)
Concern for: Ground Water, Surface Water
Contaminants: Organic and inorganic chemicals

Best Management Practices
Aside from fire retardants used in emergency situations, all forest chemicals should be managed to reduce spills or other releases that would impact drinking water sources.

Source: WAC Chapter 222-38

Underground Injection Control (UIC) Class V (Shallow) Wells

**** UIC Class V wells are shallow subsurface fluid distribution systems that are designed to place fluids directly below the ground surface. Examples of Class V wells include septic system drainfields, storm water wells, drywells, industrial or commercial disposal wells, aquifer remediation wells, abandoned drinking water wells. Ditches and trenches may be classified as UIC wells. Hazardous waste injection through shallow wells is prohibited.*

Concern for: GW
Contaminants: Various – may include storm water, solvents, hydrocarbons, motor vehicle fluids, nitrate, bacteria, viruses, septage, and others

Best Management Practices

EPA and State Regulations apply to the registration, operation, maintenance, and closure of UIC wells. Information is available on the EPA UIC website:

http://www.epa.gov/safewater/uic/index.html.
Please contact the appropriate regulatory agency for information about the rules that apply to your well:

Alaska: Wally Moon, Manager, Ground Water Protection Unit
Environmental Protection Agency Region 10
206-553-6903, or moon.wally@epa.gov

Idaho: John Sharkey, Idaho Department of Water Resources
208-287-4934

Oregon: Barbara Priest, Oregon Department of Environmental Quality
503-229-5945

Washington: Mary Shaleen-Hansen, Washington Department of Ecology
360-407-6143

Septic systems

Concern for: GW
Contaminants: Nitrates, bacteria, viruses, septage

Best Management Practices

1. Septic systems designed for more than 20 people per day, fall under State or EPA UIC Class V regulations. If septic systems are designed for fewer than 20 people per day, then other state or local regulations may apply.
2. Siting: locate septic systems far enough from drinking water sources to avoid potential contamination (minimum setback distances are typically defined by state or local governments that have oversight of UIC or septic programs)
3. Septic tanks and drainfields must be of adequate size to properly treat the volume of wastewater
4. Design should be completed by a licensed engineer
5. Installation should be completed by a licensed septic system installer and construction should not occur when the soil is wet
6. Proper operation and maintenance are imperative
7. Septic systems should be inspected annually
8. Pump septic tanks every 2 to 5 years
9. Hazardous chemicals should be taken to a hazardous waste collection site rather than disposed into a septic system

Source: Drinking Water Academy Bulletin, Managing Septic Systems to Prevent Contamination of Drinking Water, July 2001, EPA-816-F-01-021

Abandoned Wells
Concern for: Ground Water
Contaminants: Various – they serve as conduits for any pollutants; typical contaminants are storm water, solvents, nitrates, bacteria, viruses, phosphates, hydrocarbons, pesticides, and others.
Source: Potential Sources of Drinking Water Contamination Index, EPA. www.epa.gov/safewater/swp/sources1.html

Best Management Practices
Survey property to locate wells.

Properly remove or seal and abandon identified wells following state rules or procedures.
Source: Drinking Water from Forests and Grasslands: A Synthesis of Scientific Literature, United States Department of Agriculture Forest Service, General Technical Report SRS-39, September 2000, pp. 68-69.

Parking Lots
Concern for: Ground Water, Surface Water
Contaminants: Oil, gasoline, automotive fluids.
Source: Drinking Water Academy Bulletin, Managing Storm Water Runoff to Prevent Contamination of Drinking Water, EPA 816-F-01-020, July 2001

Drywells are UIC Class V wells. If drywells are used to manage parking lot runoff, then state and EPA UIC Class V rules apply to proper registration, operation, maintenance, and closure of these wells.

Best Management Practices
Design to manage runoff appropriately – grassy swales, vegetated filter strips are options.

Design to allow infiltration – permeable pavement such as concrete grid pavement is a good option.

Sweep up litter and debris, especially around storm drains or other direct connections to surface water.
Sources: Drinking Water Academy Bulletin, Managing Storm Water Runoff to Prevent Contamination of Drinking Water, EPA 816-F-01-020, July 2001. After the Storm: A Citizen's Guide to Understanding Storm Water, EPA 833-B-03-002, January 2003.

Tractor Use (Vegetation and Re-vegetation Projects)
Concern for: Surface Water
Contaminants: Sediment, turbidity

Best Management Practices
Limit tractor use to reduce gully and sheet erosion and associated sediment production. Limiting operation of tractors to gentle slopes will prevent disturbance and erosion. Any projects involving tractor use on steep slopes should include special provisions and should be monitored carefully. (p. 72)

Do not operate tractors in wetlands or meadows to limit turbidity and sediment production that result from compaction, rutting, runoff, concentration, and erosion. (p. 72)

Do not operate tractors during wet conditions, when soil surface is unstable and susceptible to damage. Limiting use based on soil moisture conditions will prevent compaction, rutting, gullying, and production of sediment and turbidity. (p.73)

Revegetating disturbed areas stabilize the areas and protect water quality by minimizing soil erosion. (p. 73)
Source: General Water Quality Best Management Practices, Pacific Northwest Region, U.S. Forest Service, November 1988.

Aboveground Storage Tanks (ASTs)
Concern for: Surface Water
Contaminants: Petroleum hydrocarbons, heating oil, other chemicals

Refer to State and Local Rules and Regulations to determine whether the state in which the AST is located has an Aboveground Storage Tank regulatory program. If a regulatory program exists, follow appropriate rules and guidance.

A Spill Prevention Control and Countermeasures (SPCC) Plan is required if the total amount of oil products on site in aboveground storage exceeds 1320 gallons, or if a single container exceeds a capacity of 660 gallons.

Best Management Practices

ASTs should have spill and overfill prevention and leak detection.

Secondary containment should be designed to contain the entire volume of the materials that can be stored in the AST.

Tanks should be protected from corrosion.

ASTs should be protected from physical damage and vandalism through use of guard posts and fencing, as necessary.

Tanks should be operated, maintained, and closed appropriately.
Source: New Mexico Environment Department Above Ground Storage Tank Program

Underground Storage Tanks
Concern for: Ground Water, downgradient Surface Water
Contaminants: diesel, gasoline, heating oil, other chemicals

EPA and State Regulations apply to the registration, operation, maintenance, and closure of USTs. Please contact the appropriate regulatory agency for information about the rules that apply to your tank:

Alaska: Wally Moon, Manager, Ground Water Protection Unit
Environmental Protection Agency Region 10
206-553-6903, or moon.wally@epa.gov

Idaho: Erik Sirs, Environmental Protection Agency Region 10
208-378-5762, or sirs.erik@epa.gov

Oregon: Wally Moon, Manager, Ground Water Protection Unit
Environmental Protection Agency Region 10
206-553-6903, or moon.wally@epa.gov

Washington: Cathy Frey, Washington Department of Ecology,
360-407-7270
http://www.ecy.wa.gov/programs/tcp/ust-lust/tanks.html