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Water-source Toolkit



Water-source Toolkit



Carolyn Napper
Soil Scientist

USDA Forest Service
San Dimas Technology and Development Center
San Dimas, CA 91773

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Tim Dedrick, transportation planner, Pacific Southwest Region, Lassen National Forest
Shane Hendrickson, fisheries biologist, Northern Region, Lolo National Forest
Rick Hopson, assistant regional hydrologist, Intermountain Region
Melanie McFarland, forest fisheries biologist, Pacific Southwest Region, Lassen National Forest
Greg Napper, civil engineer, San Dimas Technology and Development Center
Brent Roath, regional soil scientist, Pacific Southwest Region
Scott Tangenberg, hydrologist, Pacific Southwest Region, Lassen National Forest
Alan Yamada, engineering program leader, San Dimas Technology and Development Center

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Chapter 1

Introduction

The water-source toolkit provides tools to evaluate, design, and improve water sources for emergency and long-term resource objectives. The toolkit includes guideline checklists, water-source suitability forms, and drafting options. The toolkit is designed for U.S. Department of Agriculture (USDA) Forest Service interdisciplinary teams to evaluate existing and potential water-source locations on a district or forest.

Background

Water drafting draws water from streams or impoundments to fill trucks or trailers for the purpose of road construction, maintenance, dust abatement, or fire suppression. The type of water-source development varies with location, water availability, drafting equipment, access requirements, and resource objectives.

Types of water sources

- In-channel
- Off-channel
- Tanks (surface or buried)
- Dry-hydrants
- Reservoirs
- Municipal or private water sources
- Springs
- Wells
- Stand pipe

Water sources can adversely impact water quality and other resources if not properly located and designed. Common adverse effects include:

- Erosion and sediment delivery to stream.
- Streambank and streambed modification.
- Equipment leaks and spills.
- Water temperature changes.
- Stream flows reduced.
- Riparian vegetation loss.

Additionally, water sources can directly impact aquatic species through injury from pumping equipment, or by transporting eggs, larvae, and/or adults out of the aquatic system.



Figure 1—Potential for leaks and spills into stream.



Figure 2—Access road drains directly to stream.



Figure 3—Risk of erosion and sediment delivery to stream.

To prevent and reduce adverse impacts, an interdisciplinary team must review existing standards and guidelines, conduct field reviews, and develop water-source facility goals and objectives.

Standards and Guidelines

Guidelines for water drafting and water-source development are located in national, regional and forest-specific references. Prior to selecting a new water source or improving an existing source, review the following references.

Forest Land and Resource Management Plan (FLRMP), including appropriate plan amendments, referencing in particular:

- ✓ Standards and Guidelines and other management direction for water quality, aquatic species, and riparian areas.
- ✓ Aquatic management strategies such as PACFISH and INFISH.
- ✓ Instream flow requirements for the district or forest.
- ✓ Threatened, endangered, or sensitive (TES) aquatic and riparian species.
- ✓ Aquatic nuisance species (ANS) considerations for district or forest.
- ✓ Fire Management Plans (FMPs) for the district or forest.

Standards and Guidelines

- ✓ Timber Sale Administrator (TSA) - Forest Service Handbook 2409.15-2004-2
- ✓ National/Regional Best Management Practices (BMPs) for water-source development consistent with water quality protection (Clean Water Act)
- ✓ Wildland Fire Situation Analysis (WFSA) Forest Service Manual 5100, Chapter 30, Wildland Fire Suppression

Identify regulatory direction from other agencies by consulting the following:

- ✓ National Marine Fisheries Service (NOAA-Fisheries)
- ✓ U.S. Fish and Wildlife Service (U.S. DOI, FWS)
- ✓ State water rights agency
- ✓ State and Federal permitting agencies (EPA, U.S. Army Corps of Engineers)

Forest Land and Resource Management Plan (FLRMP)

The FLRMP provides direction and guidance for water quality, stream buffer widths, aquatic species, riparian areas, TES, and road construction.

Aquatic Management Strategies

Large-scale aquatic management strategies such as PACFISH and INFISH amend the appropriate forest plan and provide direction and guidance on buffer widths, riparian areas, and other areas pertinent to water-source use and development.

Instream Flow Requirements

Stream, pond, and lake level requirements are included in the FLRMP or identified by the State. Determine conditions when flows are inadequate to meet both resource and drafting requirements from drought, time of year, or other resource concerns.

TES Species

Habitat requirements for threatened and endangered species or sensitive species are included in water-source design. Identify recommendations in the biological opinion prior to evaluating new or existing water sources.

Aquatic Nuisance Species

The Nonindigenous Aquatic Nuisance Species Control and Prevention Act of 1990 (P.L. 101-646) highlights the concern for adverse impacts to native aquatic species from nonindigenous species (NAS, Web site). Water drafting operations have the potential to spread ANS through pumps and equipment. Pre-field review of potential ANS within the watershed can identify the risk level. ANS considerations may include disinfecting pumps and identifying disposal areas prior to using drafting equipment. Cleaning of equipment may be colocated with noxious and invasive weed cleaning equipment.

Fire Management Plans

Fire management plans (FMP) are updated annually prior to the fire season. FMPs are developed for a geographic area and may contain information on water drafting locations for different equipment types.

***Timber Sale Administrator
(TSA) Forest Service Handbook
2409.15-2004-2***

The TSA handbook has guidelines for design and use of water sources for timber sale operations. When a water source is needed for a timber sale, planning and design occurs during the environmental analysis. The TSA handbook identifies contract provisions (B 6.5 or B 6.34) for water-source development and use during the timber sale.

Best Management Practices

Best management practices (BMP) represent a set of techniques for preserving or restoring water quality affected by nonpoint pollution. They are the means by which the USDA Forest Service complies with the Clean Water Act. Each individual BMP describes general actions to be taken to preserve or restore water quality. Site-specific prescriptions are implemented at the field level where general BMPs are carried out through specific actions. BMPs are designed to respond to all management actions on National Forest System lands that have the potential to affect water quality including water-source development and drafting. BMPs are developed for each site; and implemented and monitored to ensure water quality objectives are met.

Wildland Fire Situation Analysis

Water drafting from streams may adversely affect aquatic species and habitat especially during spawning. Preidentify drafting and helicopter dipping sites in the Wildland Fire Situation Analysis (WFSA) to reduce impacts to aquatic species. Line officers use WFSA to document the wildland fire suppression strategy decision and can include approved drafting locations in the analysis.

NOAA and FWS

The National Marine Fisheries Service (NOAA-Fisheries) and the U.S. Department of the Interior Fish and Wildlife Service (FWS) provide direction in the form of Biological Opinion Terms and Conditions issued specifically to a forest or district as the result of consultation for federally-listed threatened (T) or endangered (E) species.

Regulatory direction varies with location and species at risk. Water-source specifications may include screen location and orientation, approach velocity, sweeping velocity, minimum screen size, screen-mesh size, shape and material type, and bypass facilities. Other direction may provide information on pumping rates and draw-down of upstream or downstream pools or lakes and ponds where potential impacts to aquatic species may exist (NMFS-NOAA, Web site).

State Water Rights

Each State has direction and guidance for water rights. Easily accessible Web sites provide information on determining instream flow requirements and maximum amount of water withdrawal. Familiarize yourself with the State water rights agency for your area. Consult State databases to identify instream and downstream flow requirements (Waterinfo, Web site).

State and Federal Permits

State and Federal permits may be required if you are constructing a new water source or modifying an existing site. Check with your State to verify if a water quality certification (401) is necessary and if there are additional State or Federal permits needed prior to construction (Clean Water Act, Web site).

Review of the guidelines and recommendations enable the interdisciplinary team to move to the next step and develop area-specific resource objectives.

Chapter 2

How To Evaluate Existing and Potential Water-source Locations

1. Develop a strategic plan for the construction of a limited number of durable long-term water sources.
 - o Enlist interdisciplinary participation.
 - o Define analysis area (watershed or project area).
 - o Define water drafting needs.
2. Establish objectives for type of use desired within the analysis area.
 - o Road maintenance.
 - o Fire emergency (frequency and amount of use).
 - o Access needed (vehicle, helicopter).
 - o Drafting deployment (portable tank, water tender).
3. Collect background information to evaluate site conditions (see appendix A).
 - o Identify locations of existing or potential water sources.
 - o Identify watershed condition (sensitivity/resilience).
 - o Identify presence of TES species.
 - o Identify aquatic nuisance species concerns.
 - o Identify instream flow requirements.
 - o Identify water quality issues.
4. Conduct a field review of existing and potential sites with the interdisciplinary team.
 - o Evaluate sites with the field suitability evaluation form (see appendixes B and C).
5. Select water-source sites and drafting methods that met team objectives.
6. Evaluate the site and treatment against original goals and objectives.
7. Redesign the water source or drafting method if goals and objectives are not met.
8. Implement treatment and monitor to assess short- and long-term effectiveness.

Chapter 3

Water Drafting Methods

Suction and ejector drafting are methods for drafting water from streams or impoundments. Both methods use a direct hose lay or pump water to a holding tank. Suction drafting uses larger diameter hard hose lines to quickly draw water to fill tanks. Ejector drafting uses a smaller hose diameter and draws smaller amounts of water to higher elevations and over greater distances (USDA Forest Service 2002).

Select the appropriate water-drafting method to achieve identified resource needs and objectives.

Suction and ejector drafting are used to fill water tenders, USDA Forest Service fire engines, and portable tanks.

Suction Drafting

Fire engines and water tenders draft water from a static source to supply a pumper. Water tenders use hard-section hose with a 4- to 6-inch-diameter hose attached to the fire engine or water tender. Water tenders are designed to transport large quantities of water. General categories of equipment capability include tank capacity (gallons), pumping capacity (gallons per minute) off-load capacity (gallons per minute) and maximum refill time. Suction drafting can be located at a variety of sites both temporary and permanent. Minimal equipment set up is required.



Figure 4—A water tender is commonly used for road maintenance.



Figure 5—Hard-section hose is commonly used with pumps and water tenders.

Portable pumps supply water directly to a temporary holding tank or hose lay for fire suppression use. These pumps are portable and can minimize impacts to riparian areas when used correctly.



Figure 6—Portable pumps are routinely used for fire suppression needs.

Application

Suction drafting is for temporary and permanent water-source locations. Suction-drafting equipment is generally located within 30 feet of the stream or water source. Hard-section hose, which comes in 8-foot lengths, is typically used to draft from the stream. Vertical lift varies with equipment capability from 10 to 15 feet (National Wildfire Coordinating Group 2004).

Close proximity to the stream increases risk of erosion from water spilling when the hard-section hose is removed from the pumper. Often tanks can overflow and cause erosion from spilling. Chemical contamination risk is present from vehicles and pumps close to the channel.

Considerations

In situations where close proximity to the drafting source is necessary, there are ways to reduce impacts through design. Maintain a well-vegetated buffer strip between the drafting equipment and the water source by using longer hard-section hose lays to increase the buffer strip.

Change the access-road gradient to ensure that any spills move away from rather than toward the stream.



Figure 7—(Before) Road drains directly to stream, strawbales trap sediment within the annual scour zone.



Figure 8—(After) Road template modified to drain away from channel.

For permanent sites, harden sites with 8 to 12 inches of clean riprap and drain rock to prevent erosion on the access road. Use existing hardened facilities such as boat launches and campground access ramps for emergency, short-term use instead of native surfaced areas prone to erosion.

Reduce the size of the facility within the most sensitive portion of the riparian area by modifying vehicle access and turn-around areas. Use existing roads and bridges for drafting.



Figure 9— Identify suitable bridge locations for drafting.



Figure 10—Incorporate existing roads to avoid creating new access routes.

*Alternate and Complementary
Techniques*

Standpipes use suction drafting and can be located outside the riparian area to reduce adverse impacts of vehicles in the streamside-management zone. Standpipes are for both temporary and permanent locations.



Figure 11—Standpipes can be located outside of sensitive areas.

Portable tanks use suction drafting and can be located outside sensitive reaches. Provide a minidam-containment system for the pump and fuel required. Minidams capture any spill from the pump or fuel and prevent soil or water quality deterioration.



Figure 12—Use barriers and containment systems to prevent spills from affecting soil and water.

Permanent tanks are generally gravity fed and can be located outside of the riparian-influence zone. Some permanent tanks use passive flows from rainfall to fill tanks and are located outside of riparian areas as well.

Ejector Drafting

An ejector integrates a nozzle and a venturi (a narrowing of a piped waterway) to create suction. Pressurized water is supplied to the inlet of the ejector. Water flows thru the ejector inlet that directs a high-velocity stream of water through the venturi. The high-velocity stream provides the flow necessary to create suction in the area between the nozzle and venturi. The ejector is the best tool when vertical lift is a constraint (USDA Forest Service 2002)



Figure 13—An ejector nozzle.

Application

An ejector can draft water vertically to heights greater than 22 feet. Water is lifted from deep wells, bridge crossings, rivers, and lakes up to 300 feet from the road.

Considerations

The ejector supplies an estimated 2 gallons of water for every 1 gallon of water that goes through the venturi. The axiom “to get water you have to give water” is commonly used with the ejector. Slower tank-fill time results from the smaller intake hose. A 40-gallon minimum is necessary to prime the ejector and charge the ejector hose lay. A spring-loaded foot valve is recommended to prohibit loss of water once the hose lay is primed (USDA Forest Service 2002).

Alternate and Complementary Techniques

When vertical lift requirements are above 18 to 20 feet, there are few techniques aside from the ejector to draft water. Helicopter buckets and drafting provide short-term emergency response.



Figure 14—Preidentify helicopter drafting locations to reduce adverse impacts to aquatic species.

Screening Devices

Regardless of the type of drafting used, provide screening devices to protect aquatic species. There are many screening devices available commercially. Some considerations include the stream channel, flow conditions, pump requirements, and aquatic species present. Screen construction criteria include the following:

- Surface area.
- Screen mesh.
- Screen design.
- Screen structure.
- Screen cleaning.

(National Marine Fisheries Service, 1996; Washington Department of Fish and Wildlife 2000; ETTfire, Web site). Consult the Web sites on screening devices for more information.



Figure 15—Screening devices protect aquatic species.



Figure 16—Floating screen devices are placed in lakes for helicopter drafting.

Chapter 4

Facility Modifications To Reduce Adverse Impacts to Resources

When changing the drafting method alone will not achieve resource objectives, interdisciplinary teams may identify drafting equipment or redesign the facility to mitigate resource impacts.

Modifications to water sources include the following:

- Hardened facility.
- Dry hydrant.
- Standpipe.
- Off-channel ponds
- Tanks.
 - o Portable tanks.
 - o Aboveground tanks.
 - o Underground tanks.

Selecting the correct modification or site location depends on the goals and objectives identified during the interdisciplinary process. The water-source suitability form identifies limiting factors. In some cases the vertical-lift height is greater than the pump capability, or instream flows are not sufficient throughout the drafting season. Regardless of which indicator is limiting, the team identifies modifications or alternatives to achieve the objectives.

Hardened Facility

Hardened facilities use pavement or rock to reduce erosion and define the extent of the facility.

Application

Identify vehicle type and use intended at the site. Provide vegetated buffers between the facility and the stream to allow for stream function (flooding) and process. Design the access roads to drain away from the water source to prevent water-quality impacts. Harden sites with 8 to 12 inches of clean riprap and drain rock to prevent erosion on the access road. Limit the size and length of the access road and ensure proper road drainage is installed and maintained.



Figure 17—Boat launches provide emergency access.



Figure 18—Site is not well armored to prevent erosion and sediment delivery.

Considerations

Use existing hardened facilities such as boat launches and campground access ramps for emergency, short-term use instead of native-surfaced areas prone to erosion. If long-term use is needed at a site, design the facility to maintain stream function and process by including a stream buffer.

Hardened facilities should be installed where there is an adequate streamflow throughout the drafting season.

***Alternate and Complementary
Techniques***

Dry hydrants are constructed in locations with paved or hardened roads to ensure vehicle access.

Dry hydrant

A dry hydrant is a nonpressurized permanent pipe assembly system installed into a water source that permits the withdrawal of water by suction. The hydrant is primed with water from the fire engine or watertruck to begin drafting (Department of Forestry Virginia, Web site).



Figure 19—Dry hydrant.

Application

The dry hydrant is typically used in areas where all-weather access to an available water source is desired. Many local volunteer fire organizations favor the dry hydrant due to its ease and relative low installation and maintenance costs. The hydrant can be located further away from the water source to reduce impacts in riparian areas. Likewise, the likelihood of spills entering streams also is reduced. The dry hydrant has a vertical lift capability between 12 to 15 feet depending on the equipment used and the length of dry pipe (NRCS 2002).

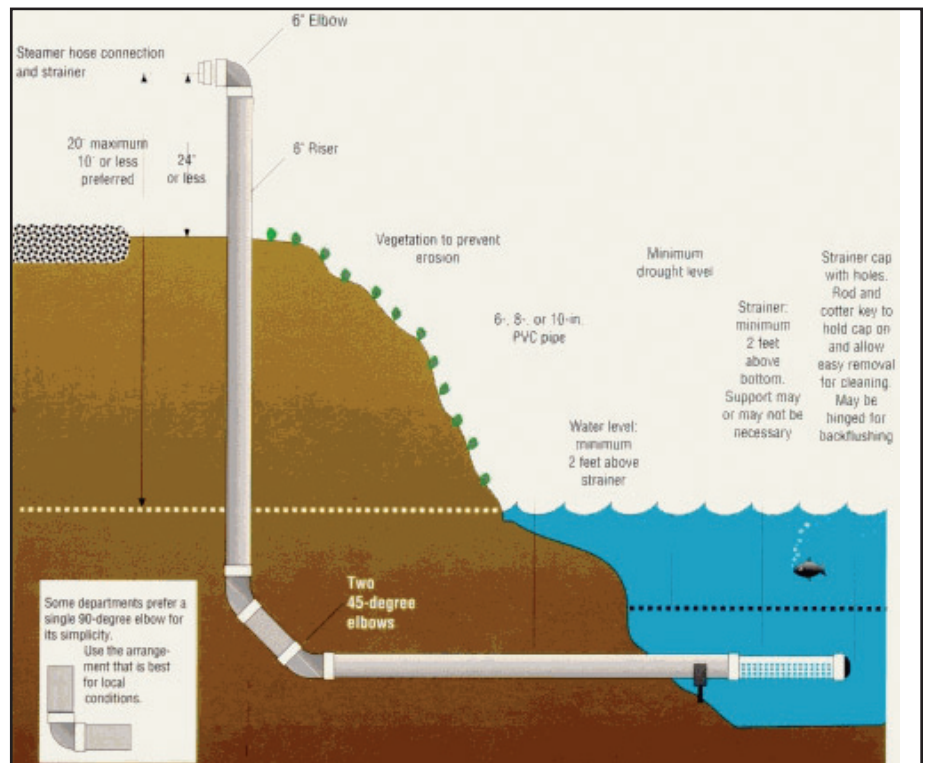


Figure 20—Dry-hydrant design.

Considerations

Consider the depth of the existing or planned water source when designing the dry-hydrant application. The low-water surface level should be approximately 4-feet deep. The suction strainer is roughly 2 feet above the bed and then another 2 feet to the minimum drought level for a total of 4 feet. If you are in a location where the water source may freeze over during the winter, an even deeper water depth is required (ETTfire, Web site).

The composition of the bottom material should be sand, gravel, or rock to prevent decaying vegetative material from clogging the suction screen. Protect the dry-hydrant site from vandals or accidents with protective housing or an impact barrier.

Dry hydrants require inspection, testing, and maintenance. After initial installation, flush the pipes to ensure removal of debris that could be harmful to pumps. Inspect the water intake to ensure silt or aquatic growth has not clogged the intake. More frequent inspections are needed on slow-moving water sources (Department of Forestry Virginia, Web site).

***Alternate or Complementary
Techniques***

The dry hydrant is used in many applications including drafting from an underground water tank or positioned on a bridge above the stream.

Standpipe

A standpipe is a tank or pipe for holding water in an elevated position to create pressure in a water-supply system.

Application

As a temporary facility, the standpipe is moved from location to location. With a pump and hose lay, the standpipe is located away from the stream or water source. Adverse impacts within the buffer area are mitigated by moving the operation outside of the most sensitive area.



Figure 21—Standpipe used for drafting.

Considerations

Standpipes are generally temporary facilities used for the length of the operation. Long-term water-source facilities can also accommodate standpipes depending on the site layout. Drafting from the water source is still required and necessary protection against hazardous material spills should be included in the pump set up. Use of a mini dam to contain spills is highly recommended (SEI, Web site).

Alternate and Complementary Techniques

The standpipe can be combined with drafting from off-channel ponds, hydrants, or wells.

Off-channel ponds

Off-channel ponds are constructed to take a portion of stream flow into a pond for drafting. The off-channel pond reduces impacts to riparian areas and streambanks by constructing the water-source development in less sensitive areas. The off-channel pond maintains stream-flow requirements and reduces streambed alteration impacts that occur with limited pool depth.



Figure 22—Off-channel pond using partial diversion of spring.



Figure 23—Off-channel pond diverts partial flow from stream.



Figure 24—Off-channel pond utilizes existing road.

Application

Off-channel ponds may use springs, diversion ditches, or pipes to move a portion of the streamflow into a pond. The pond serves as the drafting site which avoids impacts to streambanks. Off-channel ponds have been successfully constructed in areas fed by steep, stable channels where a portion of flow can be directed into the pond. Overflow pipes are used to return water to the main channel.

Off-channel ponds also may be constructed in meadows. The high water table helps maintain a minimum pool elevation which can be augmented by diverting a portion of the channel. Ensure that resource objectives are met when constructing an off-channel pond in the meadow.

Considerations

Locate the off-channel pond in an area where it will not be inundated with sediment during high flows. Minimize the access roads in sensitive locations to have a smaller “footprint” for access. Evaluate the need for an overflow back into the main channel. Off-channel ponds may have a continuous stream flow that needs to be routed into the stream. Locations adjacent to spring sites have been used successfully in this manner.

***Alternate and Complementary
Techniques***

Consider relocating off-channel water sources that are in meadows or sensitive habitat.

Portable Tanks

Portable tanks are available in a variety of sizes and can be easily assembled with few tools. Portable tanks support hard suction hose and clapper valves to maintain the prime between a pumper and a low-level or floating strainer (Fol-Da-Tank, Web site).



Figure 25—Portable tanks come in a variety of shapes and sizes.

Application

Portable tanks are designed for standby water containment and water shuttling situations to provide a continuous portable water supply. A portable pump or water tender can fill the tank. Tank sizes range up to 10,000 gallons. Portable tanks should be located away from sensitive resources to reduce impacts to riparian areas (USDA Forest Service 1994).

Consideration

Identify if your resource objectives are for emergency- or long-term needs. If long-term needs are required consider an alternate and complementary technique. If the needs are short term or emergency in nature, identify suitable sites for portable tank deployment that can be put into effect in the WFSA.

Alternate and Complementary Techniques

Permanent aboveground or belowground tanks provide a continuous water supply.

Aboveground Tanks

Aboveground tanks provide a continuous water supply for a permanent water sites. These storage tanks vary in size from 100 to 5,000 gallons. They may use solar pumps or gravity-feed systems to fill the tank. The tanks should be located outside of riparian areas to reduce impacts to stream environment.

Application

Forests use the tanks for fire suppression and road maintenance. Locate tanks outside of riparian and sensitive areas to reduce adverse impacts.



Figure 26—Aboveground tank for fire suppression needs.



Figure 27—Aboveground tank located outside of riparian area.

Considerations

Aboveground tanks are susceptible to vandalism. Solar pumps and connections can require maintenance.

Alternate and Complementary Techniques

Temporary portable tanks for emergency situations may meet team objectives for use. If an above ground tank poses risks from vandalism, an underground tank may serve the needs better.

Underground Tanks

Underground tanks are similar to aboveground tanks in that they provide a continuous supply of water. Tanks vary from 10,000 to 30,000 gallons.

Application

Underground tanks are used in areas where a permanent water-source location is required. The tanks can be filled from a variety of sources including a waterline fed by a stream or spring. Piping water to the tank allows the designer to locate the tank outside of the riparian area. The tank and fill-up area also share the same location so a much smaller facility can be designed. The defined fill-up area is often associated with an existing road. Impacts to the riparian areas or streamside zone are eliminated. All tanks provide storage of water, which is useful during low stream flows or drought conditions.

Considerations

Underground tanks require maintenance to perform reliably. Inspect the tank waterlines annually. Depending on the drafting method (dry-hydrant-suction holes) the pipe size and type may change. Consult with tank manufacturers prior to any further design (ETTfire, Web site).

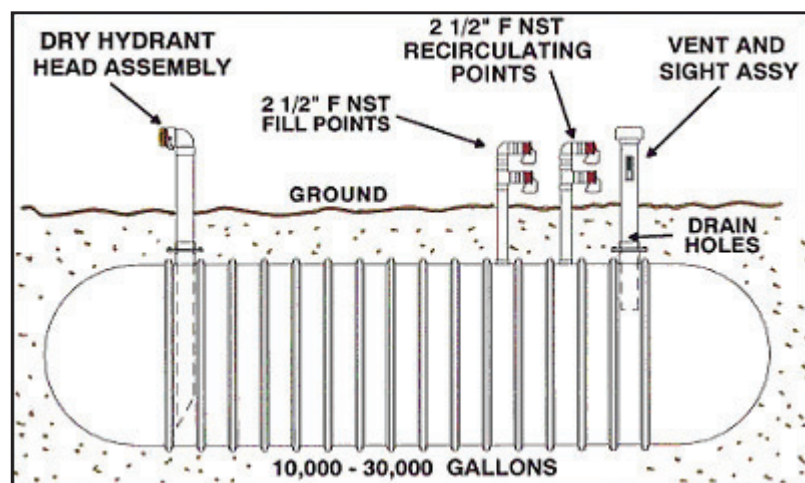


Figure 28—Underground tank.

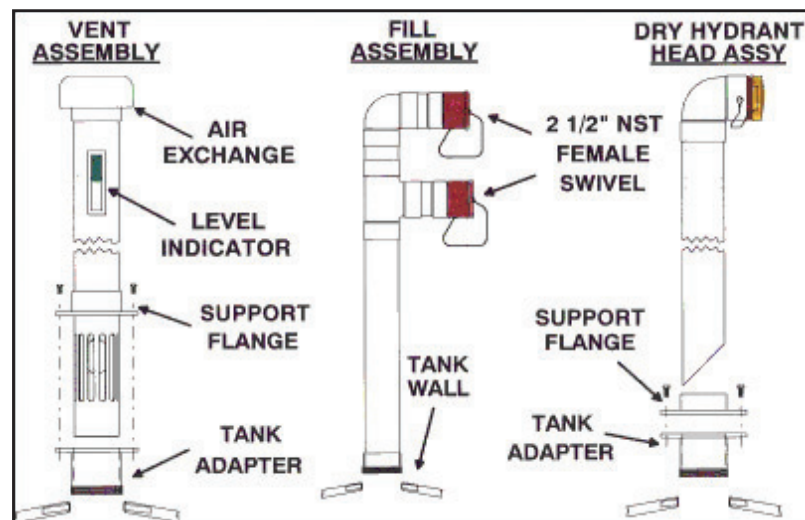


Figure 29—Pipe components for underground tanks.

Alternate and Complementary Techniques

Aboveground or portable tanks serve as alternatives for underground tanks.

Appendix A
Checklist of Applicable Direction
for Water-source Development

Forest Land and Resource Management Plan and Amendments Standards and Guidelines
Aquatic Species:
Riparian Areas:
Roads and Facilities:
Aquatic Management Strategies (PACFISH, INFISH, others):
Instream Flow Requirements:
TES aquatic and riparian species:
Aquatic nuisance species:
Fire Management Plans (FMPs):
Handbook and Manual Direction
Timber Sale Administrator (TSA)Forest Service Handbook 2409.15-2004-2
Best Management Practices (BMPs)
Wildland Fire Situation Analysis (WFSA) Forest Service Manual 5100.30
Regulatory Direction
National Marine Fisheries Service (NOAA-Fisheries)
U.S. Fish and Wildlife Service (USFWS)
State Water Rights
State and Federal Permitting Agencies (EPA, Army Corps of Engineers)
Other Direction and Guidance

Appendix B

Water-source Suitability Form

Water-source Suitability Form

Circle the correct answer for each indicator below

Indicator	NA	High	Moderate	Low
Location of facility		Minimal intrusion to riparian area	Part of facility in riparian area	Facility located in riparian area (100%)
Landscape position		Uplands-Forested areas	Floodplain	Vulnerable or unstable location - Located on outside bend of stream
Stream channel type		Well-Armored Step pool type A1, A2 (transport reach) low sediment yield	Stream types C or E stable but can adjust laterally over time	Fine-textured soils, unstable reach types D-F or G; poorly vegetated; evidence of streambank erosion
Streambank condition (includes trampling, road cuts, or other mechanical impacts to the streambank) and floodplain intrusion		Minimal impacts to streambank – does not impact floodplain processes	Some streambank impacts with limited excavation	Thru cut access road to stream edge, stream bed altered to create pond – May impact floodplain process, restrict access
Delivery potential to stream (erosion potential and connectivity to stream)		No potential for sediment or spill movement into stream	Potential for sediment to mobilize but effective filter strip	Potential for sediment to mobilize and enter stream channel.
Position of drafting site (within the streambed, floodplain)		Minimal intrusion to streambed or floodplain (hydrant)	Margin of floodplain	Constructed in streambed or other sensitive location (in-channel pond)
Streambed Alteration (includes modification of the channel bottom to create a pool for drafting or recreational use)		No identifiable modification to streambed	Some streambed modification	Streambed altered to create pool, may include creating a dam structure or mechanical modification of channel bottom
Water flow capacity		Adequate flows to maintain stream health, aquatic, and habitat needs throughout drafting season	Partially limiting flows for aquatic or habitat needs	Limited stream flows to meet Forest LRMP goals and objectives.
Height of vertical lift from water surface to vehicle loading area Height _____ft		Less than 10 foot vertical lift	10-17 foot vertical lift	Greater than 17 feet vertical lift
Water-source longevity and maintenance needs		Requires minimal maintenance between use and poses no resource risks	Requires some maintenance for operations.	Requires routine maintenance prior to use and may require maintenance/repair after high flows or floods.
Summary Suitability Rating		_____	_____	_____

Add up the circled indicators in each column (High, Moderate and Low) to rate each site.

NA = Not applicable at site

High = Site is HIGHLY suitable for a water source.

Moderate= Site has some constraints, which requires mitigation and project design modification.

Low = Site has severe constraints, which may dictate an alternate location or drafting method.

Prefield Office Review of Existing Data

Indicator	N/A	High	Moderate	Low
Watershed and stream reach condition		Watershed Condition Class I. The drainage network is generally stable.	Watershed Condition Class II. Portions of the watershed may exhibit an unstable drainage network	Watershed Condition Class III. A majority of the drainage network may be unstable.
Presence of TES species		TES Species absent; outside range of TES species distribution	Potential for TES species presence; presence not confirmed	Presence of TES aquatic or riparian species, and unique or endemic (non-TES) species and/or habitat
Aquatic Nuisance Species		No nuisance species on or near forest	Nuisance species present on forest, but not within 5 th field watershed	Nuisance species present at site or within 5 th field watershed
Proximity to other water sources		> 10 miles	5 -10 miles	< 5 miles
Summary/Comments				

Atmospheric pressure= 14.7 psi. A pressure of 14.7 psi is capable of lifting water 2.3 ft for every lb of pressure 2.3 ft/1 lb psi up to 33.9 feet (2.3 ft X 14.7 = 33.9)

Diagram stream, pond, access road, and other uses including recreational activities below:

Appendix C further defines the 14 indicators used to complete the Water-source Suitability Form in appendix B.

Appendix C

Indicators of Water-source Suitability

Name of indicator: Location of facility

Description of indicator: Location of facility indicator addresses the size and percent of the facility within the riparian or streamside buffer. In many cases, the facility is 100 percent within the streamside buffer. The facility includes access road, turnaround spot, truck staging, and the drafting area. Numerous options exist to reduce the disturbed area within the streamside buffer. Options include filling the watertruck from an existing road, limiting the size of turnaround areas, use of portable tanks positioned outside the area, piped diversions to offsite storage tanks, ejector drafting, and maintaining vibrant riparian buffers.

Questions potentially addressed:

1. How much of the facility is located within the streamside buffer?
2. How and where does the facility cause surface erosion?
3. How and where does the facility create the potential for pollutants, such as chemical spills or oils to enter surface waters?
4. How and where does the facility affect shading, litterfall, and riparian plant communities?
5. How and where does the facility contribute to fishing, poaching, or direct habitat loss for at-risk aquatic species?
6. How and where does the water-source facility enable the introduction of aquatic nuisance species?

Units of indicator:

High – Little or no intrusion into riparian area. No adverse impacts to the buffer from the water-source facility.

Moderate – Part of the facility is located within the buffer and it may or may not be adversely impacting the buffer or stream.

Low – All of the facility is located within the buffer and it may or may not adversely impact the buffer or stream.

Scales: This indicator is validated at the site scale but can be combined with a geographic information system (GIS) review of water-source locations at the project, subwatershed, or watershed scale. The location of facility indicator provides a first cut for teams developing a limited number of durable, long-term water sources that meet resource objectives.

Related indicators:

- Landscape position
- Delivery potential

Utility: Useful as an initial selection; requires field review to assess buffer impacts.

Acquisition: Buffer the GIS stream channel and riparian areas for a specified distance and insert the water-source coverage. Identify areas of overlap and follow up with the field suitability rating form in the field.

Name of indicator: Landscape position

Description of indicator: The landscape position indicator addresses the durability of the water-source location. Water-source facilities located within the active floodplain are vulnerable to erosion, flooding, and sediment deposition. Vulnerable or unstable locations require frequent inspection. Water-source facilities located in stable, upland forested areas may be more durable.

Questions potentially addressed:

1. How and where does the facility affect stream, riparian, and meadow processes?
2. How and where does the facility create the potential for pollutants, such as chemical spill or oils to enter surface waters?
3. How and where does the facility cause surface erosion?
4. Is the facility located in an unstable or dynamic location which may require routine maintenance?
5. Is the facility location potentially subjected to flooding or mass wasting?

Units of indicator:

High – Located in stable areas including uplands or forested areas.

Moderate – Located within the floodplain.

Low – Located in a vulnerable or unstable location (prone to mass wasting, streambank erosion, headcutting).

Scales: Landscape position is validated at the site scale and is combined with GIS review of water-source locations at the project, subwatershed, or watershed scale.

Related indicators:

- Position of drafting site.
- Stream channel type.
- Streambank condition.
- Water-source longevity and maintenance needs.

Utility: Landscape position is most useful when combined with the related indicators. Districts and forests can develop a correlation between landscape position and water-source longevity and maintenance needs.

Acquisition: Map the water-source coverage with digital-elevation models. The slope position macro can be altered to create the number of different slope positions desired.

Name of indicator: Stream channel type

Description of indicator: The stream channel type indicator is a method for evaluating water-source condition relative to the stream type. The stream-type indicator allows the team to predict the channel response and extrapolate site-specific data to stream reaches having similar characteristics.

The indicator is used to equate stability with stream type. Combine other indicators from the prefield assessment including watershed condition in this analysis. The indicator also serves to help determine the type of facility that is compatible with the stream type.

Questions potentially addressed:

1. How and where does the facility affect stream, riparian, and meadow processes?
2. How and where does the facility cause surface erosion?
3. Is the facility location potentially subjected to flooding or mass wasting?
4. How and where does the facility affect streamflows?
5. How and where does the facility affect channel dimension, pattern, and profile?
6. How and where does the facility affect shading, litterfall, and riparian plant communities?
7. How and where does the water-source facility enable the introduction of aquatic nuisance species?

Units of indicator:

High – Channel is steep, entrenched, cascading step/pool stream. Very stable bedrock or boulder-dominated channel.

Moderate – Channel is moderately entrenched, has a *Moderate* gradient, is a riffle dominated channel. Typically channel types “B, C, or E.”

Low – Channel may be types “D, F, or G”. Low gradient channels in association with floodplains, alluvial soils, and are potentially laterally or vertically unstable.

Scales: This indicator is used at the reach scale. Inferences can be made to other similar stream types at the project, subwatershed, or watershed scale.

Related indicators:

- Landscape position.
- Streambank condition.

Utility: The stream-type indicator can be refined by a forest to identify significant stream types for a geographic area. The following provides a thorough breakdown of stream-channel-type indicators for stability.

A1, A2, generally stable, low sediment yield. (**High**)

A3, A4, A5, A6, unstable, high sediment yield, A6 also associated with mass-wasting processes. (**Low**)

Typically, all B’s are relatively stable, either due to bed substrate composition, or dense riparian vegetation. **B1, B2, B3, B4 (High); B5, B6 (Moderate)**

C1 very stable, can adjust laterally over time (**Moderate**)

C2 stable, can adjust laterally over time (**Moderate**)

C3, C4, C5, C6, susceptible to accelerated bank erosion, rate of lateral adjustment influenced by riparian vegetation. **C4, C5, C6** also susceptible to vertical adjustment. **C5, C6** can have active lateral migration tendencies--dependent on riparian vegetation. (**Low or Moderate**) depending on current vegetation health.

D3, D4, D5, D6 unstable--High bank-erosion rates, excessive deposition, annual shifts in bed location (**Low**)

E3, E4, E5, E6, very stable unless disturbed and significant changes in sediment supply and/or streamflow occur. Bank stability from dense riparian vegetation. (**Moderate**)

F1, F2 very stable. (**High**)

F3 unstable unless well vegetated (**Low or Moderate**), depending on vegetation health.

F4, F5, very unstable – High streambank erosion rates, unless very well vegetated. (**Low**)

F6, more stable than **F3** to **F5**, but subject to mass wasting, and very sensitive to disturbance, adjust rapidly to changes in flow regime and sediment supply. (**Low**)

G1, G2 very stable. (**High**)

G3, G4, G5, G6 highly unstable, both vertically and laterally, very sensitive to disturbance and tend to make significant channel adjustments to changes in flow regime and sediment supply (**Low**)

Acquisition: Stream survey data forms contain invaluable information by reach. Combining GIS data regarding presence of fish and TES species can help identify both suitable and unsuitable locations for water-source developments.

Name of indicator: Streambank condition and flood-plain intrusion

Description of indicator: Streambank condition identifies the existing streambank condition of a water source. Impacts may include trampling, road access, riparian vegetation condition, and mechanical manipulation of the streambank from constructed road cuts.

Questions potentially addressed:

1. How and where does the facility cause surface erosion?
2. How and where does the facility affect shading, litterfall, and riparian plant communities?
3. How and where does the facility affect stream channel processes?
4. How and where does the facility create the potential for pollutants such as chemical spills or oils to enter surface waters?

Units of indicator:

High – No obvious impacts to the streambank and does not impact flood plain processes. Field review indicates healthy riparian areas, good soil cover, and no hydrologic connectivity between the water-source facility and the stream.

Moderate – Streambank conditions indicate some impacts to riparian vegetation, surface erosion, and areas of soil compaction. The streambank buffering capability is partially intact and minor impacts to the streambank stability.

Low – Little to no riparian vegetation or streambank buffering capacity. Through-cut road created to access stream. Vehicle access within the flood prone area or active channel may occur.

Scales: This indicator is used at the site scale.

Related indicators:

- Streambed alteration.
- Position of drafting site within the flood plain.
- Sediment or spill potential to stream.

Utility: This indicator may identify impacts from other uses of the facility such as dispersed recreation. Resource impacts from recreation use may exacerbate the streambank condition rating. Interdisciplinary teams should map and record the existing recreation use. At a subwatershed or watershed scale identify the overlap of water source facilities and dispersed recreation sites. As an interdisciplinary team, identify resource objective for all resources prior to developing a site restoration or improvement plan.

Name of indicator: Delivery potential to stream

Description of indicator: Delivery potential addresses the hazard of sediment or chemical contamination entering the stream. Facilities with hydrologically connected access roads pose the highest risk for water-quality concerns. Hydrologically connected is defined as any road segment that has a continuous surface flowpath to a stream channel. This indicator addresses the placement of pumps and water trucks during drafting. Locating a portable pump immediately adjacent to the stream provides connectivity to the stream. A water truck can spill water from its tank once it is filled up. Spills can create erosion and carry sediment to the stream channel.

Questions potentially addressed:

1. How and where does the facility cause surface erosion?
2. How and where does the facility create the potential for pollutants, such as chemical spills or oils to enter surface waters?
3. How and where the facility is hydrologically connected to the stream channel?
4. How and where does the facility affect water quality?

Units of indicator:

High – No potential for sediment or spill movement into stream. No hydrologic connectivity exists between the facility and the stream channel. Water-source facility is designed to mitigate erosion and trap sediment.

Moderate – There is a potential for sediment or chemical spills to occur but an effective buffer strip traps material.

Low – The facility is hydrologically connected to the stream channel, and sediment and chemical spills can enter the stream channel.

Scales: This indicator is validated at the site scale and is useful as a prioritization tool when comparing other water-source facilities within the project, subwatershed, or watershed area.

Related indicators:

- Location of facility.
- Streambank condition.

Utility: This is the only field indicator that specifically addresses hydrologic connectivity and spill prevention capability. Both of these components are important in maintaining water quality under the Clean Water Act.

Name of indicator: Position of drafting site

Description of indicator: Drafting-site position identifies how the drafting area affects the streambed and streambank. This indicator breaks the facility into components of access road, turn-around area, and drafting location. The indicator identifies the drafting mechanism. A water tank with a passive rainfall collection system would rate this “NA” for not applicable on the suitability form. If water was diverted in a pipe to a collection tank, the rating is “minimal intrusion.” In some cases, streambeds are altered to create ponds or stream channel diversions. The severity of the impact depends on the stream channel type and location of the facility.

Questions potentially addressed:

1. How and where does the facility cause surface erosion?
2. How and where does the facility create the potential for pollutants such as chemical spills or oils to enter surface waters?
3. How and where does the facility contribute to fishing, poaching, or direct habitat loss for at-risk aquatic species?
4. How and where does the facility alter stream channel processes?
5. How and where does the facility affect shading, litterfall, and riparian plant communities?
6. How and where does the water-source facility enable the introduction of ANS?
7. How and where does the facility affect streamflows?

Units of indicator:

High – Minimal intrusion to the streambed or flood plain as a result of the type of drafting.

Moderate – Facility is within the floodplain but may include only an access road to a channel pool. No actual streambank or streambed modification is observable.

Low – Facility is constructed in the streambed (cofferdam) and may divert flows into a pond or span the entire stream.

Scales: This indicator is used at the site scale.

Related indicators:

- Landscape position of facility.
- Stream channel type.
- Streambank condition and flood plain intrusions.
- Streambed alteration.
- Water-source longevity and maintenance needs.

Utility: This indicator is most useful when combined with the above related indicators. Identifying the type of disturbance may help the team in evaluating the indicator.

Acquisition: This indicator requires field review to rate.

Name of indicator: Streambed alteration

Description of indicator: The streambed-alteration indicator identifies if mechanical manipulation of the streambed and streambed materials (in-channel pool construction or rearrangement of boulders) was used to create a pool. Or, if temporary or permanent devices were added to change, redirect, or alter flows to increase pool depth.

Questions potentially addressed:

1. How and where does the facility affect stream flows?
2. How and where does the facility affect stream, riparian, and meadow processes?
3. Is the facility location subjected to flooding?
4. How and where does the facility contribute to fishing, poaching, or direct habitat loss for at-risk aquatic species?

Units of indicator:

High – No identifiable modification to the streambed.

Moderate – Streambed alteration minimal and may include temporary pooling of some flows. No significant alteration to channel form or profile from treatment.

Low – Streambed altered to create pool changing channel pattern and profile. May adversely affect downstream flows and could increase sediment to channel in a storm event.

(Note: In some areas with *High* recreational use, small to large dams are created for wading. These streambed-alteration structures should be mapped, photographed, and included in the project analysis).

Scales: This indicator is used at the site scale. Information from site surveys can be compiled at the project, subwatershed, and watershed scale for more comprehensive analysis.

Related indicators:

- Facility location.
- Stream channel type.
- Streambank condition.
- Water-source longevity and maintenance needs.

Utility: This indicator is most useful when combined with the above-related indicators.

Acquisition: This indicator requires field review to rate.

Name of indicator: Water-flow capacity

Description of indicator: Water-flow capacity provides the team with information on the suitability of a site for drafting and providing downstream beneficial uses. The indicator identifies constraints to drafting due to in-stream flows. This indicator also can identify limitations in lentic systems where water drawdown may affect resources.

Questions potentially addressed:

1. How and where does the facility affect stream flows?
2. How and where does the facility contribute to fishing poaching, or direct habitat loss for at-risk aquatic species?
3. How and where does the facility affect stream, riparian, or meadow processes?

Units of indicator:

High – Adequate flows are present year round to maintain stream health, aquatic species habitat, riparian vegetation, and downstream beneficial uses during drafting.

Moderate – Flow supply may be partially limited to provide for aquatic-species habitat and other downstream beneficial uses during drafting.

Low – Instream flows are known to be limited and variable between years. Use of a water source in these streams can affect beneficial uses.

Scales: Useful at the site, reach, subwatershed, and watershed scale.

Related indicators:

- Height of vertical lift.
- Water-source longevity.
- Streambed alteration.
- Proximity to other water sources.

Utility: This indicator identifies limitations in water supply. Combined with the related indicators the team can identify alternate locations or methods to draft water and obtain resource objectives.

Name of indicator: Height of vertical lift

Description of indicator: Vertical lift is a stratification tool for pumping equipment capabilities, a key consideration when identifying potential water-source locations for both fire suppression and dust abatement. The amount of vertical lift at a site may require alternate pumping equipment such as ejectors to draft water successfully.

Questions potentially addressed:

1. Does the site provide emergency or long-term needs or both?
2. How and where does the facility affect stream, riparian and meadow processes?
3. How and where does the facility create the potential for pollutants, such as chemical spill or oils to enter surface waters?
4. How and where does the facility cause surface erosion?
5. Is the facility located in an unstable or dynamic location that may require routine maintenance?
6. Is the facility location potentially subjected to flooding or mass wasting?

Units of indicator:

High – There is less than 10 feet of vertical lift from the water surface to the pump.

Moderate – There is 10 to 17 feet of vertical lift from the water surface to the pump.

Low – There is greater than 17 feet of vertical lift from the water surface to the pump.

Scales: This indicator is valid only at the site scale.

Related indicators:

- Stream-channel type.
- Water-source longevity and maintenance needs.

Utility: This indicator is most useful when combined with the above-related indicators, as forests may develop a correlation between vertical lift and stream-channel type.

Name of indicator: Water-source longevity and maintenance needs

Description of indicator: The water-source longevity and maintenance-needs indicator identifies the hazard and risk associated with a site. Facilities requiring frequent maintenance may fall into disrepair and pose a serious risk to resource values. Developing and selecting suitable sites to maintain water-source longevity requires thoughtful consideration of all resource needs both present and future.

Questions potentially addressed:

1. Is the facility located in an unstable or dynamic location which may require routine maintenance?
2. Is the facility location subjected to flooding or mass wasting?
3. How and where does the facility affect stream, riparian, and meadow processes?
4. How and where does the facility affect channel dimension, pattern, and profile?

Units of indicator:

High – Water-source facility requires minimal maintenance between uses and poses no resource risks. When the facility is not used there are no potential impacts to resources, nor is the facility itself compromised by flooding or other natural disturbances.

Moderate – The water-source facility requires some maintenance to operate. Examples include reconnecting a pipe, modifying or cleaning a screen, or adjusting the pool level.

Low – The facility requires routine maintenance prior to use. The type of maintenance may include removing deposited sediment, repairing or reestablishing diversion ditches, relocating a portion of the facility due to streambank erosion, or repairing breaches. In most cases the maintenance requires heavy equipment to perform the task.

Scales: This indicator is useful at the site scale but may be combined with other sites in the project area to establish the amount of maintenance needed throughout the project.

Related indicators:

- Location of facility.
- Position of drafting site.
- Steam-channel type.
- Streambed alteration.

Utility: This indicator is useful to the team for identifying the sites that require the most maintenance and pose a resource threat. Facilities may be redesigned or removed depending on resource objective and long-term needs.

Name of indicator: Watershed and reach condition

Description of indicator: Watershed and reach condition is a prefield stratification of overall stability. If a subwatershed has recently burned, *High* sediment yields may occur for the first several years, which could affect maintenance requirements of a water-source facility. Watershed stability can be reviewed by the team at the watershed scale and fine-tuned with field surveys at the subwatershed and reach scale to provide more accurate information on condition.

Questions potentially addressed:

1. How and where is the watershed (analysis area) unstable?
2. What is the cause and effect of the instability?

Units of indicator:

High – The upstream and downstream areas are stable and well vegetated. There are no known disturbances that could adversely affect the site.

Moderate – There are some indicators of stream reach instability including streambank erosion, channel aggregation or degradation, and reduced riparian vegetation.

Low – Extensive areas of streambank erosion, active landslides, and impaired water quality.

Scales: This indicator is most useful at the subwatershed scale.

Related indicators:

- Proximity to other water sources.
- Streambank condition.
- Stream type.
- Water-source longevity and maintenance needs.

Utility: Combine watershed condition with the related indicators. The overall condition of a watershed helps the team select long-term durable sites. However, obtaining accurate watershed condition evaluations is difficult and available information may be at too broad a scale for specific sites. This indicator is useful at the broad scope and then supplemented with reach-specific subwatershed field reviews.

Name of indicator: Presence of TES species

Description of indicator: Federally listed (Threatened or Endangered), USDA Forest Service Sensitive (TES), and unique or endemic (non-TES) aquatic species habitat (current/historic). The threatened or endangered species overlays water-source sites with important aquatic habitat at the subwatershed scale (7th field). This scale was selected, because

1. The extent of TES/unique aquatic species occurrence/habitat is not easily defined at finer scales.
2. Cumulative effects of water sources to aquatic habitat at the subwatershed scale can be analyzed.

For some species, the 5th or 6th field-scale watershed may be more appropriate to use instead of the 7th field subwatershed.

Questions potentially addressed:

1. How and where do water sources affect important aquatic species and their habitat?
2. To what extent do water sources overlap with areas containing important aquatic species?

Units of indicator: Presence or absence of TES or unique aquatic species within a subwatershed (5th, 6th, or 7th field)

High – Outside known range of TES or unique aquatic species and potential suitable habitat unlikely based on habitat conditions.

Moderate – TES or unique aquatic species known to be present historically, but species have not been detected based on formal surveys.

Low – TES or unique aquatic species are known to be present.

Scales: Useful at the site, reach, subwatershed, and watershed scale

Related indicators:

- Stream reach and watershed condition.
- Water-flow capacity.

Utility: Water-source facilities can be designed to accommodate threatened, endangered, or sensitive species.

Name of indicator: Aquatic Nuisance Species

Description of indicator: The presence of aquatic nuisance species (ANS) in streams or impoundments used for drafting can adversely affect ecosystem health. Equipment that has been exposed to ANS also poses a risk when used at new drafting locations. The indicator raises an awareness of the potential impact of ANS to the ecosystem and helps interdisciplinary teams identify mitigation measures.

Questions potentially addressed:

1. How and where do water sources aid in the transfer and dispersal of ANS?
2. To what extent do water sources and known locations of ANS overlap?

Units of indicator:

High – No nuisance species on or near the forest.

Moderate – ANS present on forest but not within 5th field watershed of proposed or existing water source.

Low – Nuisance species present at site or within 5th field watershed.

Scales: Useful at the site, reach, subwatershed, and watershed scale

Related indicators:

- Stream reach and watershed condition.
- TES.

Utility: Knowledge of the presence or absence of aquatic nuisance species within the analysis area can help in site selection and mitigation measures.

Name of indicator: Proximity to other water sources

Description of indicator: Determining the location and proximity of other water sources within a geographic area enables the team to identify a limited number of durable, long-term water sources. Consider water-source locations on other land jurisdictions if access is available. The number and proximity of water sources may depend on haul routes, fire suppression needs, values at risk, travel time, and type of water source (emergency or long term). Districts can preidentify potentially suitable sites for emergency use that are quickly reviewed at the time of the emergency.

Questions potentially addressed:

1. What is the intended use of the water source?
2. Does the water source provide emergency and long-term needs?
3. Are there different requirements for vehicle access?
4. Is helicopter access required?

Units of indicator:

High – There is a suitable water source approximately 10 miles.

Moderate – There are water sources within 5 to 10 miles but their condition and suitability is unknown.

Low – There are water sources within 5 miles but their condition and suitability is unknown.

Scales: Subwatershed, watershed, district, or forest scale.

Related indicators:

- Water-flow capacity
- Water-source longevity and maintenance needs

Utility: A map or GIS coverage of existing water sources provides the geographic distribution of potential drafting sites. Combine the water-source layer with main arterial and collector routes for chip vans and logging trucks. Identify key access and egress routes for fire suppression to develop a limited number of durable, long-term water source developments.

Appendix D
Best Management Practices for Existing and
Potential Water-source

Definition: Water-source developments include the access road, turn around, and drafting area.

Items To Consider When Implementing Best Management Practices:

1. Water quality protection measures for water sources in environmental documents.
 - Address buffer area for water-source development in the erosion control plan.
 - Address size of development (amount of bare soil with reduced infiltration capability).
 - Consider hydrologic connectivity and spill prevention.
 - Identify mitigation measures to reduce erosion and sediment.
2. Limits or guidelines established for water use/withdrawal
National Marine Fisheries Service (NMFS) Water Drafting Specifications (NMFS Southwest Region 2001). (For illustration purposes only; consult local jurisdiction guidelines.)
 - Pumping rate shall not exceed 350 gallons per minute.
 - The pumping rate shall not exceed 10 percent of the stream flow. Restricting drafting to 10 percent of the stream flow provides adequate downstream flow to support fish, aquatic insects, amphibians, and other biota. Ten percent of flow may be estimated by pump operators.
 - Consult long range management plan for drafting requirements for resource protection (may identify a cubic feet per second limit).
 - The effect of single or multiple pumping operations at the same location shall not result in obvious draw-down of either upstream or downstream pools (NMFS 2001).
 - Restrict operations to daylight-only prevents the use of light that will attract fish to the drafting pool (NMFS 2001).

Other considerations for drafting

- Evaluate capacity and recharge of lake/pond/reservoir and potential impacts to habitat with drafting and draw-down impacts.
3. Facility constructed and maintained to minimize or prevent erosion.
 - Facility location.
 - Access road slope.
 - Access road length.
 - Development size (bare exposed soil).
 - Facility and stream hydrologic connectivity.
 4. Source is designed and constructed such that damage from storm flows is minimized.
 - Location of facility (proximity to stream).
 - Position of drafting pond (within the streambed, floodplain).
 - Stream-channel type.
 - Stream reach and watershed condition.
 - Site longevity and maintenance requirements.
 5. Streambank alteration and excavation is minimum to provide water source
 - Method of drafting at site may dictate amount of excavation or alteration.
 - Activity within streambed (excavation or moving rocks and boulders to create a drafting pool).
 - Stream-channel type.
 - Height of vertical lift from water surface to vehicle loading area.

The water-source suitability form is used to determine existing suitability of water sources as well as locations of potential new water sources. Inventory of existing water sources allows a district or forest to determine which water-source developments are maintained or upgraded to meet BMP 2-1 “Water-source Development Consistent with Water Quality Protection.”

Water-source developments are aimed toward the construction of a limited number of durable, long-term water sources rather than the construction of a succession of hasty, expedient, development that are rapidly abandoned. Permanently designed sources, such as small piped diversions to offsite storage tanks or ponds will result in the lowest, long-term effects (2000, USDA Forest Service Pacific Southwest Region).

Appendix E

Water-source Related Internet Links

Appendix E contains useful Internet links to water-source related topics.

Environmental Protection Agency (EPA) Web sites:

<http://www.epa.gov/owow/monitoring/>

Information on the EPA's water-quality monitoring.

<http://www.epa.gov/owow/monitoring/repguid.html>

EPA's water-quality monitoring guide.

<http://www.epa.gov/owow/monitoring/wsa/index.html>

EPA's wadeable stream guide.

Water truck drafting Web sites:

<http://www.southern-fire.com/tankers.html>

Information on water truck drafting capabilities.

<http://www.dfiequipment.com/ContactUs.htm>

Information on water trucks.

Streamflow Web sites:

http://nationalatlas.gov/articles/water/a_streamflow.html

Information on streamflow data.

<http://water.usgs.gov/waterwatch/.html>

Provides real time streamflow information.

<http://www.caf.wvu.edu/~forage/streamflow/estimat.htm>

Provides useful information on measuring streamflows.

http://www.r6.fws.gov/wtr/water_measure.htm#TOP

Information on streamflow measuring devices.

5-counties link:

http://www.5counties.org/PDF_Files/Roads%20Manual/CHAPTER%203%20-%209-02.pdf

The manual provides information on roads and water source guidelines.

Fish screens and strainers Web sites

http://www.5counties.org/PDF_Files/Roads%20Manual/APPENDIX%20D.pdf

Appendix D of the 5 counties document addresses fish screens.

[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex889?opendocument](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex889?opendocument)

Simple screening devices which have to be evaluated for the type of fish you are keeping out.

Pumps and tanks Web sites

<http://www.sei-ind.com/cfm/index.cfm?It=900&Id=30&Se=9,20>

Information on containment systems for pumps.

<http://www.sei-ind.com/cfm/index.cfm?It=900&Se=8,13>

Information on portable tanks.

<http://www.westernshelter.com/product.php?ID=109>

Information on portable tanks.

<http://www.fol-da-tank.com/>

Information on portable tanks.

<http://pump-rite.com/>

Information on screens for pumps used in low-flow situations. (Ryan Becker)

http://www.ettfire.com/underground_tanks.html

Information on underground tank. installation.

http://www.ettfire.com/hole_requirements.html

Information on requirements for underground tank installation including size of hole and proper tank venting.

Dry hydrant Web sites

<http://www.dof.virginia.gov/fire/dry-hydrants.shtml>

Information on dry hydrants.

http://www.co.larimer.co.us/wildfire/dry_hydrant_concept.htm

Information on dry hydrant installation. The article recommends vertical lift of no more than 12 feet.

http://www.ettfire.com/bridge_installations.html

Installation of dry hydrant on bridge.

http://www.ettfire.com/flush_kit.html

Installation of a dry hydrant at ground level. This article provides information on design and installation considerations. Good reference.

Water drafting Web sites

<http://swr.nmfs.noaa.gov/hcd/WaterDrafting-02.htm>

National Marine Fisheries water drafting specifications.

<http://swr.nmfs.noaa.gov/hcd/WaterDrafting-02.PDF>

This reference provides information on water drafting considerations.

<http://ecomunity.uml.edu/lowellfd/draftingmanual.pdf>

Provides basic information on water drafting from a static water source.

The manual provides information on how to assess lift and equipment capabilities.

Aquatic Nuisance Species and Nonindigenous Aquatic Species Web sites

http://bio.fsu.edu/~miller/HOMEPAGE/mss/Kolar_Lodge_02.pdf

Information on aquatic nuisance species.

<http://nas.er.usgs.gov/>

The U.S. Department of the Interior U.S. Geological Service Web site provides a repository of information on Nonindigenous Aquatic Species (NAS) for the United States.

Water rights Web sites:

<http://www.ecy.wa.gov/programs/wr/rights/water-right-home.html>

Washington water rights.

<http://www.idwr.state.id.us/water/rights/>

Idaho water rights.

<http://www.waterrights.ca.gov/>

California water rights.

<http://www.waterinfo.org/index.htm>

Colorado water information.

http://www.stream.fs.fed.us/news/streamnt/apr02/apr_02_01.html

Water rights information.

Additional Web sites

<http://www.cleanwateract.org/pages/c8.cfm>

Clean water act information and permit guidance.

<http://www.deq.state.ne.us/surfacew.nsf/pages/swma>

Information on Nebraska's nonpoint source monitoring.

Topic-related national publications from San Dimas Technology and Development Center (SDTDC).

<http://www.fs.fed.us/eng/pubs/pdf/02511205.pdf>

Water Ejectors for Use in Wildland Firefighting.

<http://www.fs.fed.us/eng/pubs/html/94571307/94571307.html>

Dip Tanks for Type 1 Helicopter Operations.

<http://www.fs.fed.us/eng/pubs/html/03511203/03511203.html>

Anadromous Fish Strainers for Use in Wildland Drafting Operations.

<http://www.fs.fed.us/eng/pubs/html/02511306/02511306.html>

Water-Gate™ Instant Water Barrier.

SDTDC's national publications are available on the Internet at:

<http://www.fs.fed.us/eng/pubs/>

USDA Forest Service and U.S. Department of the Interior Bureau of Land Management employees also can view videos, CDs, and SDTDC's individual project pages on their internal computer network at:

<http://fsweb.sdtc.wo.fs.fed.us/>.

For additional information on the Water-source Toolkit project, contact Carolyn Napper, project leader, by phone at 909-599-1267, ext. 229, or by e-mail at: cnapper@fs.fed.us.

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