

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.

